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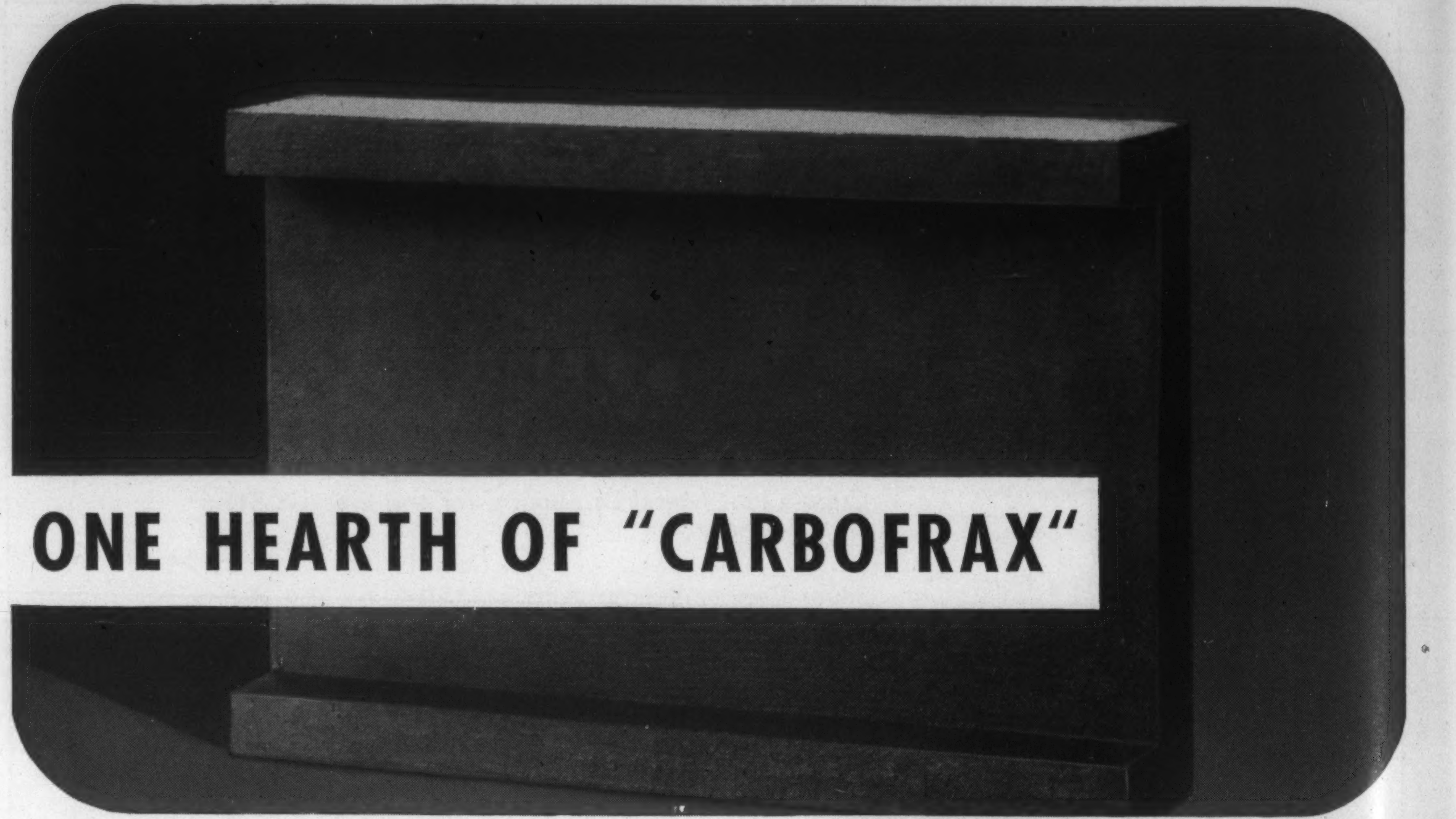

ONE HEARTH OF "CARBOFRAX"

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IN the production of high speed steel tools such as machine knives in the famed Latrobe, Penna. District, "Carbofrax" Hearths are increasing production, making possible well worth while savings on fuel, and are showing much longer life than fireclay hearths. Eighteen months of continued service as against six months is the rather startling comparison. Three times the life.

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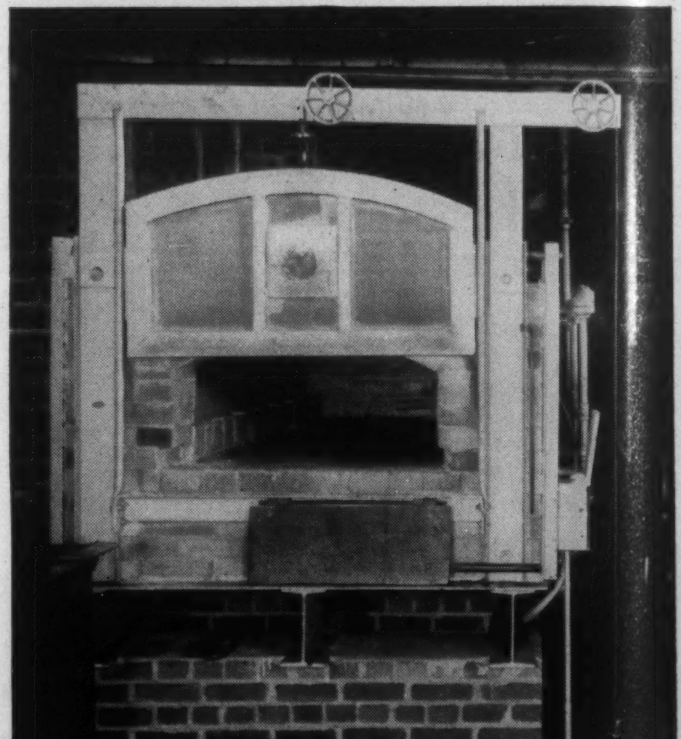

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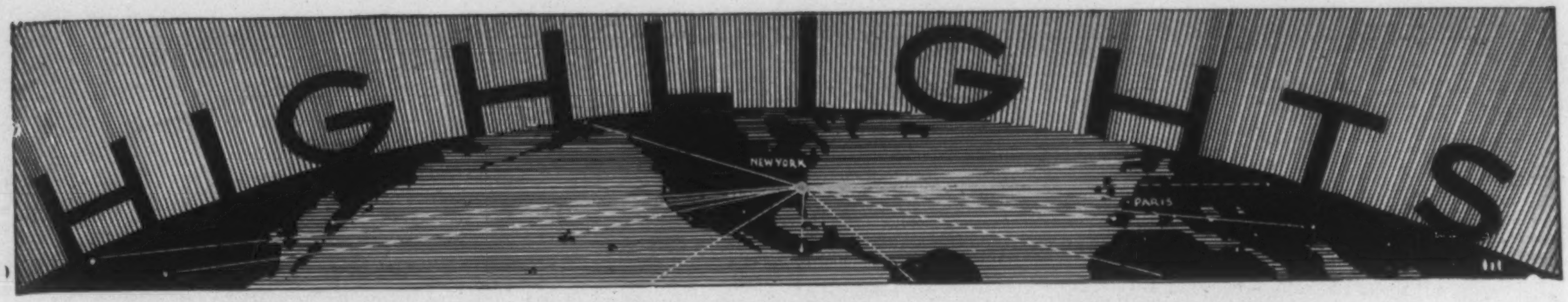

Written by the Abstract Section Editors and the Editorial Staff

DO YOU want to know what metallurgical engineers are saying, the world over? Look in the Current Metallurgical Abstracts. Here are some of the points covered by authors whose articles are abstracted in this issue.

Bessemer Ahoy

The English are now making some Ni-Cr-Mo cast steels in the Bessemer converter (page MA 576 R 2).—C. H. H.

Clean Acid Steel

A comprehensive study of the cleanliness of acid steel (page MA 575 L 4) shows that type of slag and additions of deoxidizers control the type of inclusion present and that the size of the inclusion in the ingot depends on the cooling rate. —C. H. H.

Truth is Stranger than Fiction

McConnachie (page MA 576 R 3) recommends the use of slaked lime in the blast of the Bessemer process. See if you can find the catch.—C. H. H.

Gears

Schenck comes close to telling all about the metallurgy of gears, from the Buick standpoint, anyway. The abstract is long (page MA 580 R 2) but the article is worth it.—H. W. G.

What About Reading Russian and Japanese?

Of 19 abstracts for section 5, 7 and 4 are from Russian and Japanese publications, respectively. Reading the originals of these articles will present a problem for most metallurgists; therefore, it is to be hoped that the abstractors have done a good job.—O. E. H.

A Use for Decarburization

Since high carbon is needed to make a 7 per cent Mn steel austenitic, Valenta and Koselev (page MA 582 R 10) use such a steel for the tough core and decarburize the surface to produce a martensitic case.—H. W. G.

Steels for Welding

Jasper (page MA 588 L 3) remarks that the old idea of a weld as a butt joint between good pieces of steel no longer holds, that the quality of welding is better than that of steel, i. e., a poor joint is more often ascribable to steel not properly chosen for welding rather than a poor weld itself.—H. W. G.

Fatigue on Welds

Although the abstract is under welding, those interested in fatigue will want to see the abstract on Welding Research at the Royal Naval College, Greenwich, since it discusses axial vs. rotary fatigue tests and promulgates a theory of cracking under repeated stress. Comment is made that yield strength and endurance limit will be the ultimate criteria in choice of steel for shipbuilding (page MA 588 L 5).—H. W. G.

Alcohol in Welding

Kirste (page MA 588 L 8) advocates a new electric welding outfit with concentric carbon electrodes, between which an arc is struck, and alcohol vapor blown through the space between. The arc-flame is used like a torch. The abstract doesn't say whether ethyl alcohol or some non-potable one is used, but if it's ethyl, the outfit might find a hearty welcome among some workmen.—H. W. G.

Bright, But Not Brilliant

Stout (page MA 592 R 7) says that's what so-called "bright" nickel deposits are.—H. W. G.

Casting, Riveting and Welding

Every method of construction has its limitations which render the products made by it somewhat less than ideal. For example, some of the limitations of the casting process are: (1) Parts should be of fairly uniform thickness throughout with no sudden changes in cross-section, (2) the shape must be such that it can be economically molded, (3) large or intricate members may have to be made in several separate pieces, which later are machined, keyed and bolted together, (4) castings must be entirely of one material.

In riveted constructions, excess materials must sometimes be used to provide sufficiently strong connections, large numbers of auxiliary members such as splice and gusset plates and clip angles are necessary, and awkward expedients must sometimes be resorted to merely to provide sufficient clearance to insert and drive the rivets.

With welded-steel structures, about the only limits as to size and shape are those imposed by machining and shipping facilities. Thick and thin members can be welded together. Strong rigid box-shaped sections, often difficult to cast, are easy to make by welding. Various materials can be combined in one piece. As steel is twice as stiff as cast iron, welded-steel structures usually are more rigid. However, the smaller, more intricate sections of large constructions such as cored bearings, bosses and similar parts on large machine casings, are much more economically made of steel castings which are welded to the larger rolled steel parts to form a composite finished structure, combining the advantages of both processes, without the limitations of either. Low carbon steel castings are easily welded to rolled steel sections and this modern construction method has many advantages which offer designers unique freedom from previous restrictions (page MA 588 L 7).—E. V. D.

Pro and Con

Etchells (page MA 603 L 9) advocates as much as 30 per cent Ni in stainless steels to prevent weld decay, while Kinzel in an article published in Russian (page MA 604 L 6) suggests cheapening stainless by replacing most of the Ni by Mn.—H. W. G.

Cast Iron Pipe

Doc. MacKenzie, who knows his cast iron pipe, thinks that work by Schlick and Moore on behavior of pipe under combined bending and pulling, as in underground use of pipe, is all to the good (page MA 603 R 6).—H. W. G.

On Magnetic Testing

A German pamphlet of some fifty pages has been written about magnetic powder tests for soundness of metals. The method, like all other tests, is good for some jobs, poor for others, and metallurgists should know which is which (page MA 596 R 3).—C. S. B.

A Comparison of Tests for Zinc Coatings

W. R. Meyer (page MA 596 R 5) runs through the methods for determining the thickness of zinc coatings and separates the reliable from the unreliable in an article abstracted in this issue. —C. S. B.

Nickel Anode Merry-Go-Round

The production of nickel anodes by electrolytic deposition to be used later as anodes for nickel plating may seem like a misprint at first glance. It seems to be economical, however, in Germany (page MA 593 L 2).—H. S. R.

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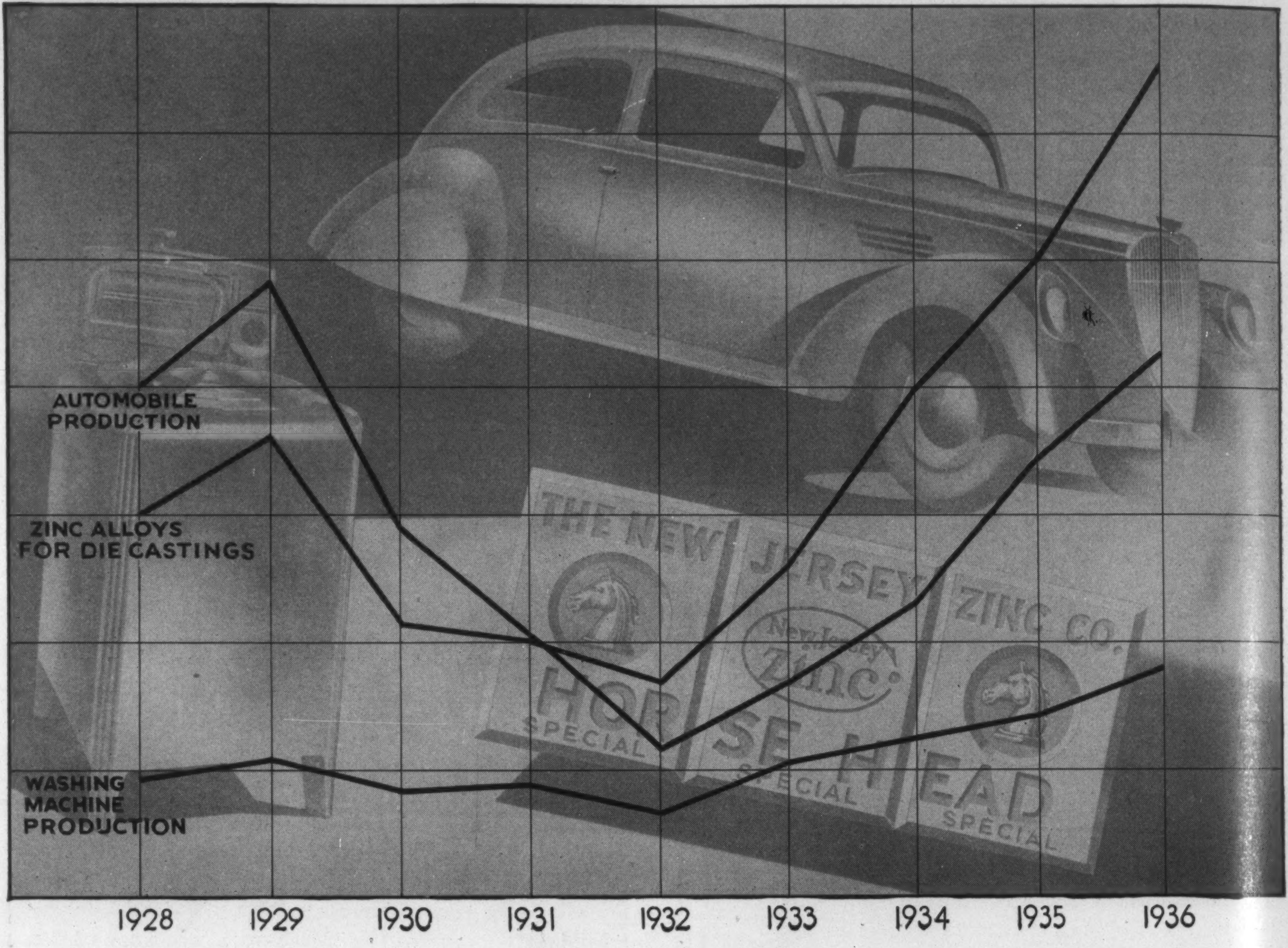

THERE MUST BE A REASON!

Using for comparison the production figures of two of the largest consumers of ZINC Alloy Die Castings—automobiles and washing machines—we follow the production of ZINC Alloy for Die Castings from 1928 through 1936.

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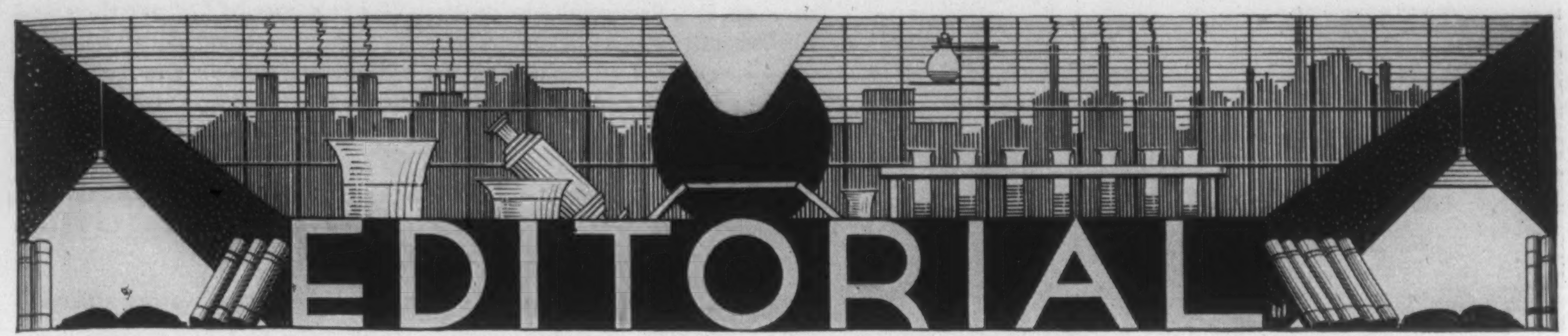

Damping

To most American readers, the German work on damping, carried out by Föppl at the Wöhler Institute, is but little known. Few libraries have the Mitteilungen in which the work appears, and even those who, like the writer, try to follow and to abstract the reports, have considerable difficulty in grasping just what it's all about. The reports carefully avoid generalizations, but instead give in detail the behavior of each bar tested so that one has to read every word. The vocabulary and style are sufficiently distinct from those of most writers of metallurgical German to make it a formidable task adequately to follow the Wöhler Institute work.

Hence it is doubly pleasant to find that Prof. Föppl presented, at the September, 1936, meeting of the British Iron and Steel Institute, a paper dealing with the general subject rather than with detailed tests and that this was translated into very readable English by Prof. F. Bacon, of Swansea, who has been a frequent visitor to Föppl's laboratory and has been able to discuss fatigue and damping problems with him. Bacon's appendix on the symbols and terminology used by Föppl will be of much value to those who study the past and future issues of the Mitteilungen.

Every one interested should read Bacon's translation. This note is to direct attention to it rather than to attempt to abstract it. However, it might be pointed out that workers in fatigue have been insisting in recent years that ability to stand overload, or high local stress, is of at least as much importance as the actual location of the endurance limit. Moore's discussion of "crackless plasticity," and the work of French, and of Russell and Welcker on the "damage line," are evidences of the broadening point of view of the testing engineer. The way the railroads stick to wrought iron for some parts subject to repeated stress, the data on sucker rods, and the behavior of the Ford cast crank shaft all indicate the importance of some property or properties, not commonly evaluated, that measure the ability of a material to take punishment without starting a failure.

Föppl relates damping to fatigue only as it affects the ability of a part to stand up under local inelastic deformation, when there is some plastic deformation and some dissipation of energy in the form of heat generated by plastic deformation. Materials of high damping can distribute energy as heat rather than to concentrate that energy into disruption by an advancing crack. Föppl believes that relative freedom from notch sensitivity under repeated stress and high damping capacity go hand in hand, and that to protect a part against overload it should be made of high-damping material.

An interesting point made by Föppl is that damping capacity is an integrated, over-all property of a part, not affected by small discontinuities or weak spots. Beside the ability of high-damping materials to dissipate energy as heat, and to distribute local stress over wider areas by virute of the ability for plastic deformation the damping hinders the setting up of forced, periodic vibrations in the whole structure and thus guarantees against the development of high local stresses. In welded ships, for example, there is absent the structural damping of riveted joints which can slip a trifle and thus use up and distribute energy, so that vibration is more easily set up than in the old riveted construction. A material which will inherently possess damping characteristics and that can be welded is definitely needed. Föppl hopes for the development of steel that will show, even at very low stresses, the damping that cast iron shows, i.e. it should have a very slightly curved stress-strain diagram of a nature similar to that for cast iron.

Obviously, if damping is so important a structural property in repeatedly stressed members, methods for its determination are needed, so Föppl briefly discusses the methods available.

Interest in, and work on, damping is not confined to Germany. Several American laboratories are studying it, though few of their results are on record. The General Electric laboratory takes a broad-minded view, probably realizing that the damping situation is so confusing that order will only come out of chaos after many experiments have been recorded and many minds have grappled with their meaning. At any rate, without attempting to draw any final conclusions, Brophy and his co-workers have given a series of reports on damping, the most recent being at the Oct. 23 Symposium on Plastic Working of Metals, during "Metals Week." This brings up several points that seem of more than passing interest.

By carrying out damping tests at higher temperatures than have been used in the German work, Brophy finds indication that some light may be thus thrown on creep problems, though he takes care to point out that such tests will probably relate only to the initial states of creep. He also notes a difference in damping between the solution stage and the precipitation state in some alloys capable of precipitation-hardening, which offers possibility of a new avenue of approach to some of the problems of precipitation-hardening. Grain, size, too, has a marked effect.

With Brophy's evidence as to possible close relation between damping and creep, Föppl's statement that different lots of steel of similar composition and treatment show wide variations in damping, and the evidence set forth, among others, by Jenkins and coworkers, that different lots act widely differently in creep (as we pointed out editorially in our September issue), one wonders whether the peculiarities noted in these two directions may not both be manifestations of the same causes. Since both damping and creep connote plastic deformation, this thought, brought out

(Continued on page 330)

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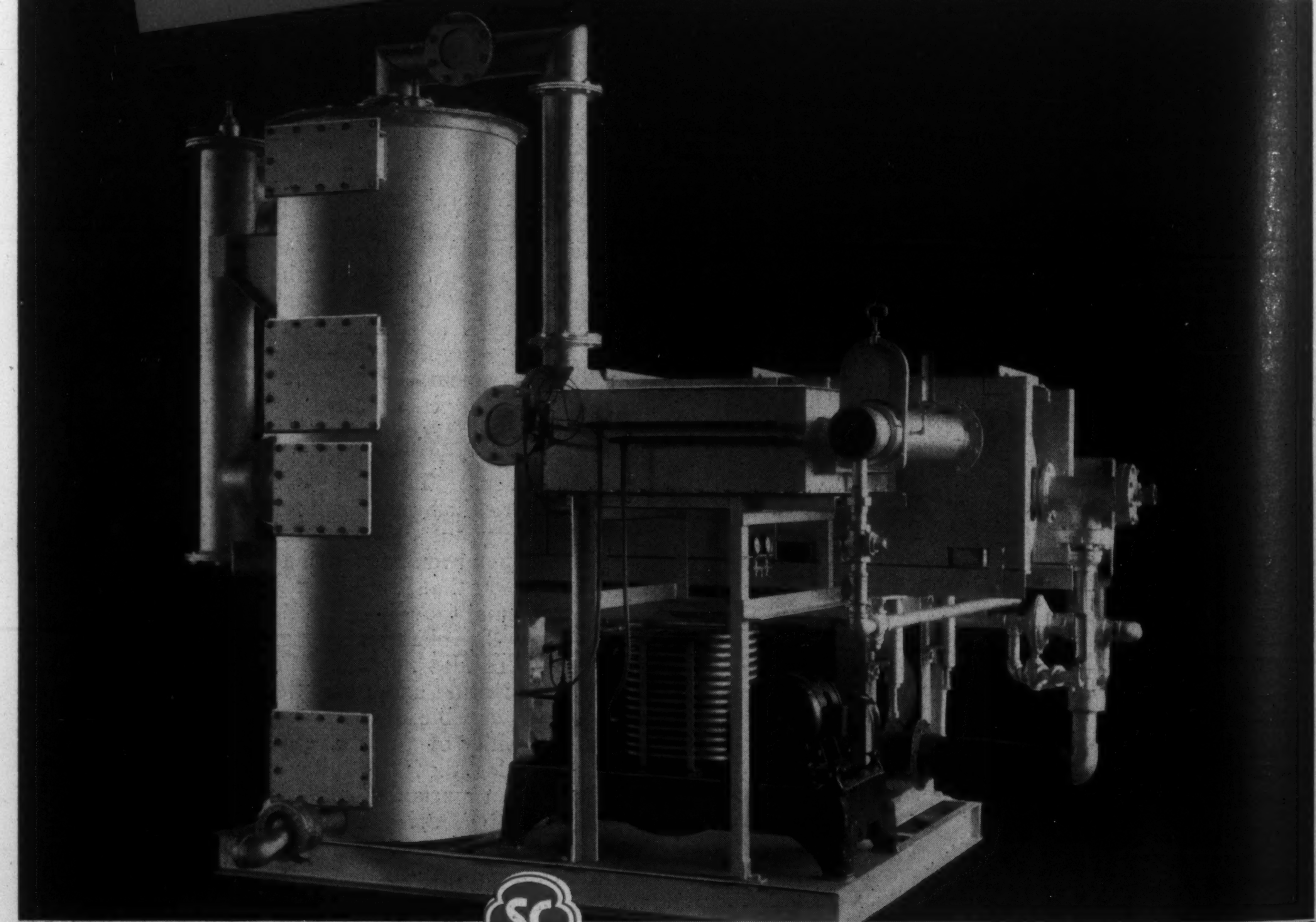

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Cupola Hot Metal Duplexing

for the

Electric Steel Foundry

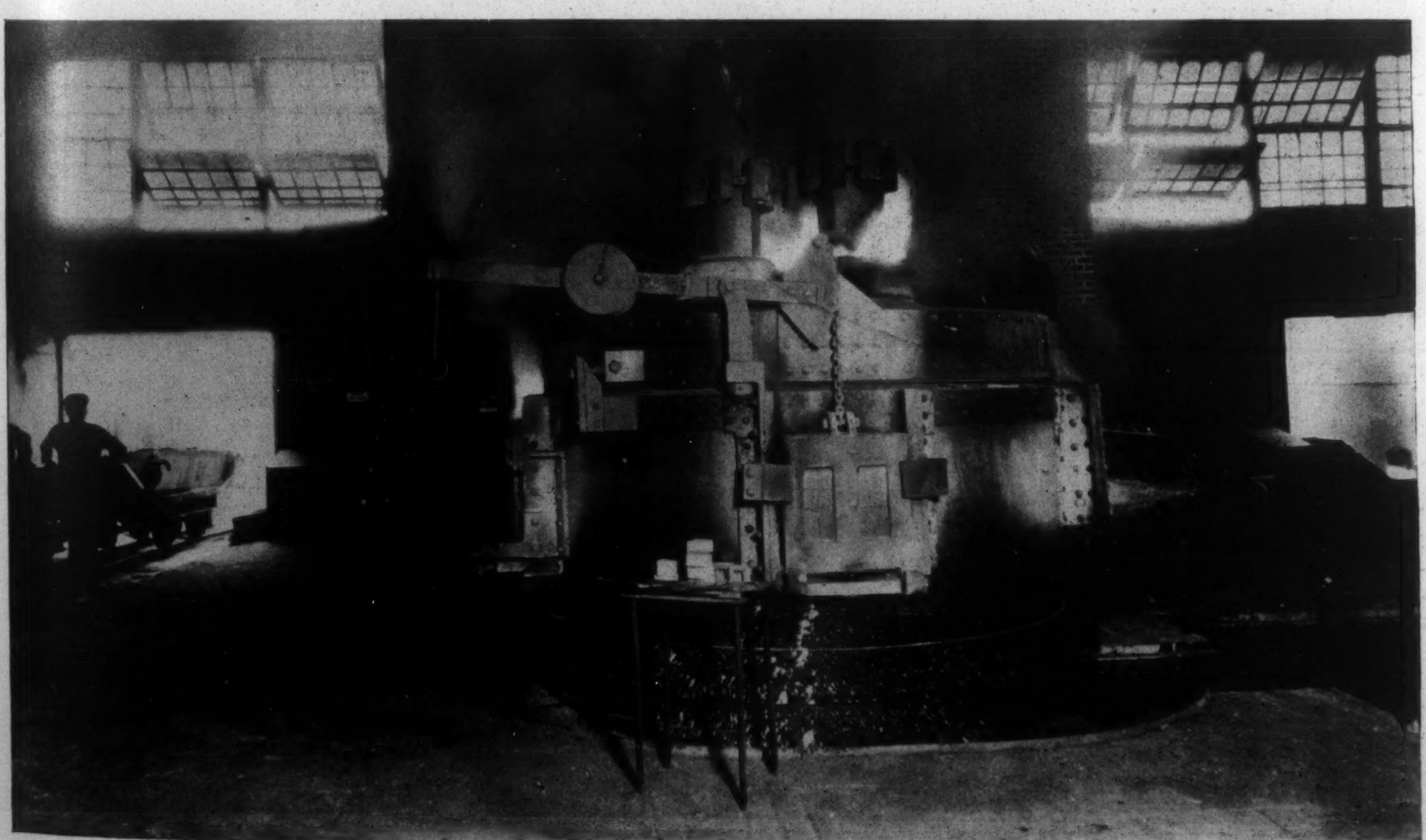
By H. B. KINNEAR and H. W. GILLETT
Battelle Memorial Institute, Columbus, Ohio

THE AVERAGE STEEL FOUNDRY needs a small flexible furnace capable of producing a variety of compositions, capable of intermittent use, and of heating the metal hot enough to pour thin castings.

The 20 or 30-ton open-hearth is the most commonly used melting unit in the American steel foundries of high production. But it is seriously lacking in flexibility from the point of view of small heats, or of intermittent use. Securing orders to keep a 20 or 30 ton furnace busy is a task that many foundries found peculiarly difficult during the depression.

The 2 or 3 ton acid converter is suitable for intermittent use in this country and prior to 1919 was the chief melting tool in steel foundries requiring small heats and flexibility of operation. From 1919 on the electric furnace out-stripped the converter, because of the high price of low phosphorous pig for converter use, because of the high metal loss in the converter and because the electric furnace can satisfactorily handle a charge high in lower cost raw materials such as turnings, borings, flashings, etc., the electric came to be the

A 3-Ton Heroult Electric Arc Furnace, the Size and Type Utilized for Producing Alloy and Other Steel Castings.



standard steel foundry tool for small melts, because it gave the lowest cost metal at the spout on small heats.

As long as the steel foundry could keep an electric busy, in localities where power was available at normal prices, the electric could cold melt charges high in cheap scrap, and maintain its economic superiority. However, when the depression forced even the 3-ton electrics to stand idle much of the time, the foundrymen discovered that the power cost per ton of melt rose above the "normal" figure in a disconcerting fashion.

Power Contract Based on Two Main Factors

The usual power contract is based upon two main factors, the energy charge, for the power actually used, and the demand charge. The latter is a capital charge to repay the central station for holding, ready for the foundryman's use, sufficient generating and transmission equipment to supply all the power wanted at anytime it is wanted. The demand charge is based on the rate of power input the furnace takes at its highest load, while the energy charge is based on the total energy used. When the furnace is run steadily, the demand charge is divided over a large tonnage and does not cut much figure. But when intermittent operation makes the divisor small, the dividend remains the same, so the quotient gets larger. Hence the demand charge per ton assumes a much larger proportion to the energy charge.

The foundryman calculates his "fuel" cost for an electric furnace by dividing the amount he pays per month (irrespective of the items that made up this amount or how they are figured) by the number of tons of metal melted in that month. He figures his power cost per kilowatt hour by dividing the month's bill by the month's kilowatt hours. Most comparisons, in the books on electric furnace practice and in the literature of electric furnace builders, take the effective cost as not far from 1c per k. w. h. In periods of steady production a good many foundries served by the larger central stations do earn rates that figure out somewhere between 0.9 and 1.1c per k. w. h. At such rates cold melting in the electric unit maintains its economic advantage in competition with other melting media in general use for small melts.

However, when low production brought the monthly melt to a low figure, these same foundries found that their effective power rate rose to 1.35c, 1.5c or even 2c and above. Since it takes some 600 to 650 k. w. h. to cold melt a ton of steel and perhaps half the melt goes into heads and gates the 1.35c figure and the 2c figure respectively meant at least some $4 or $12 per ton of good castings higher conversion cost than when the foundry was running full. This increase could not be passed on to the customer.

The foundries immediately sought relief, and, in general, found the central stations willing to share the burden. A common way out of the dilemma was for the foundry to go on night operation when the central station could waive the demand charge, though there are obvious drawbacks to night work.

There were border-line cases where, even with the best efforts of the central station, it was impossible to work out a rate that would allow operation of the electric on intermittent use, and the furnace was shut down pending enough orders to run it at a steady enough rate to be economical. Such foundries, lacking the use of their electric furnace, are looking into means of bringing it back into service at an economical cost, or failing that, to find an alternative melting method. Even where business has picked up sufficiently to make

Pouring in Cupola Metal into a Detroit Rocking Electric Furnace Preparatory to Duplexing.

Charging Door of a Modern Cupola with an Assemblage of Various Materials for the Charge.

the problem not one of immediate and pressing interest, the spectre of slack times haunts the foundryman and he wants to be able to plan what he shall do in their recurrence. He might even be willing to pay a bit higher melting cost than in the past, when the plant is running full, to have insurance against excessive costs when it is running slack. Hence the whole matter of a small, flexible, steel foundry furnace is being re-opened and foundrymen are studying all possible furnaces and processes.

The central stations are equally interested in measures for maintaining their steel foundry power load. Utilities Coordinated Research, Inc., a group of central stations seeking to find ways of meeting the present and future requirements of their customers more effectively, requested Battelle Memorial Institute to look into the situation as regards the steel foundry. This report deals with work upon this problem.

Duplexing with the Standard Open-Hearth

For the preparation of small heats of hot, fluid, steel of any desired alloy content, it is possible to duplex the product from the standard-sized open-hearth, transferring the hot metal to the electric, superheating and alloying it as needed, with much lower power consumption and much lower demand than in the case of cold melting. The large foundry with steady production of plain carbon steel for heavy castings can thus meet the requirements of its customers for small special heats more cheaply than by cold electric melting, but the method only meets this particular condition, not that of the small jobbing foundry which lacks the large back-log of heavy castings.

Use of the Small Open-Hearth

The use of a small open-hearth, of say 5 tons capacity, which with its slower rate of heating would have even less output than a steadily-run 3-ton electric, has been suggested, but, like any open-hearth, a small one needs to be run steadily and cannot stop and start with the facility of an electric, nor is it as easy, under the oxidizing flame of the open-hearth, to control the composition of a special alloy heat, not made in steady repetition, as it is under the non-oxidizing atmosphere of the electric.

The Fuel-Fired Rotary Furnace

When small fuel-fired furnaces for foundry use are being considered, more attention is being paid to rotary furnaces, with most of the discussion centered on those fired with pulverized coal, since these are coming into some use on gray iron and malleable iron, with an occasional effort especially in foreign installations, to adapt them to steel melting.

The effective combustion of pulverized coal requires plenty of combustion space, thus calling for a fairly large furnace, and even with high preheat on the air supply through a recuperator system, such furnaces often have difficulty in getting the required temperature for steel melting, and this difficulty is the greater the smaller the furnace. Still more vital in the consideration of such furnaces, for which so far only silica refractories have been found at all adaptable, is the low lining life of the rotary furnace, foreign experience indicating a life only of the order of 50 heats at steel-melting temperatures.

Oil-Fired Rotary Units

Oil-fired rotaries seem, on the basis of foreign experience, to be of more promise than coal-fired ones in respect to reaching the necessary temperature, but the lining life is still likely to be a stumbling block and since the trials of the old Carr furnace, introduced some 25 years ago and long since discarded, there seems to be little American experience with such furnaces on steel, and what little there is is not recorded in publications. Such furnaces certainly cannot be dismissed as hopeless, but their application to the immediate problem would seem to entail a considerable amount of further experiment and development before a steel foundry would be able to rely on them for reliable production under American conditions. Other alternatives need to be looked into.

All of these open-hearth and rotary furnaces, with their strongly oxidizing atmospheres, require fairly heavy melting stock and lack the ability of the electric to handle cheap borings.

The Electric and the Converter

The actual foundry requirements for a truly flexible, small, steel furnace seem best met either by the electric or the converter. Despite a certain prejudice against converter steel, the old-timers in the steel foundry business know that a well-run converter makes very good steel for castings. Moreover present-day specifications, with the exception of those for a few very special grades, usually rather highly alloyed steels, admit open-hearth, electric, and converter steel on an even basis. The converter therefore needs to be evaluated on the score of economics rather than to be discarded on the score of quality.

It was on the economic basis that the electric originally displaced the converter, and as long as the same conditions hold, as then held, the converter cannot compete. From the point of view of intermittent use, however, the converter does have the desired flexibility. The cupola that supplies it can be started up when desired and will provide hot metal at short notice, the converter blow itself is short since a converter can make 3 heats per hour, and 2 or 3-ton converters are the normal size. The metal loss of some 15 percent in cupola and converter has to be figured with the cost of melting, and, partly on account of this loss, selected low phosphorus melting stock is required.

When the converter was in its prime, special high priced low phosphorus pig was used, for it was not general practice then to melt steep scrap in the cupola to produce hot metal for the converter, so the cost comparison was between high and low cost raw materials. Today the melting of all steel scrap in the cupola is commonplace, and while a small amount of high silicon pig would be charged to the cupola to produce hot metal of around 1.7 percent Si, the charge as a whole need not be much more expensive than an acid open-hearth charge. Sulphur taken up in the cupola can be removed by soda ash treatment, which was not much used in the hey-day of the converter, so that sulphur does not limit the process as it was once thought to.

Cupola converter melting, as it would be done today, calculates out to balance up fairly closely with electric cold melting with power at 1c per k. w. h. In isolated cases converters are still used as the main melting medium of the foundry, while a few plants operating electric furnaces on night schedule hold converters in reserve to use when the call for metal is sufficient to throw the electric program over into the day time with an attendant high demand charge. This is good proof that the converter is slightly more expensive or at least less desirable, than electric melting at 1c per k. w. h. and decidedly cheaper than the electric at 2c per k. w. h. On an even cost basis the electric is the choice from the operating point of view.

A matter of some importance from the point of view of the foundry industry as a whole is that skilled converter operators are nearly extinct, while there are many skilled electric furnace operators. Another angle is that in the making of highly alloyed steels one may wish to add more alloy than can be properly taken up in the ladle, and only those few alloying elements that are less readily oxidized than iron can be put into the converter itself, so that one's style is less cramped with the electric where no such limitations exist.

Converter-Electric Duplexing

With the knowledge that converter melting costs approximate those of cold electric melting with power at 1c per k. w. h., a duplexing process where the converter supplies hot low-carbon steel to the electric for recarburizing, alloying, and final "killing," comes into consideration. Such a process has been used when it was necessary to get greater output from the electrics in plants having both converters and electrics. It was successfully applied at the Naval Gun Factory during the war.

Converter-electric duplexing used to be employed on ordinary malleable, and pearlitic malleable of 1.50 percent C is today made at one plant by passing half the cupola output to the converter, then mixing it with the unblown other half in the ladle and transferring it to an electric for superheating.

Cupola-Electric Duplexing

In the hot metal practice of the basic open-hearth furnaces in a steel mill, blast furnace metal is fed to the open-hearth where it is mixed with scrap and "ored down." Analogous practice in a foundry electric furnace would allow the primary melting of the charge in the cupola and avoid the necessity of providing a converter.

In discussion of the subject of foundry steel melting with Geo. Batty, an expert on steel castings, he remarked that the use of cupola hot-metal, duplexed to and ored down in the electric, should be a feasible method of cutting down both power consumption and demand charges, and that, while he had not personally tried it, from his own general experience and some specific tests by F. A. Melmoth, he saw no reason why it would not work out. He informs us that Melmoth applied the process at the Braintree Foundry Co., in England in 1923, taking down 2 tons of cupola metal of the unusually low figure of 2.4 percent C to 0.2 percent C in ½ hr. or less.

It was found that J. H. Hall had made the same suggestion, on page 188 of his book "The Steel Foundry," published in 1914. Hall says:

> Under ordinary conditions, if it is not deemed advisable to install an open-hearth furnace or a converter to supply the electric furnace with hot metal, it may in some cases pay to melt the scrap in a cupola and eliminate the carbon absorbed from the coke, and the phosphorus and sulphur, in the electric furnace. As far as the author is informed, this method has never been put in practice. In an electric furnace of the usual type the elimination of the carbon will be a slow and rather costly procedure; but by using a furnace without doors in the back, with the bottom carried well up the back wall, the hot metal practice used in tilting open-hearth furnaces could be followed.
>
> By melting down and heating up a little plate scrap in the furnace, and forming with iron ore a slag very rich in iron oxide, and then pouring in, melted with iron ore, a slag very rich in iron oxide, and then pouring in melted scrap (and possibly some pig iron) from the cupola, a lively reaction could be maintained, which would boil out the carbon very rapidly. By tilting the furnace back the slag could be kept from boiling out the doors, and during the violent part of the boil it is probable that current would not be needed. It is probable that the elimination of the carbon from the bath would take less time and consume less power than the operation of melting the cold scrap in the electric furnace itself, so that a saving could be made over that method.

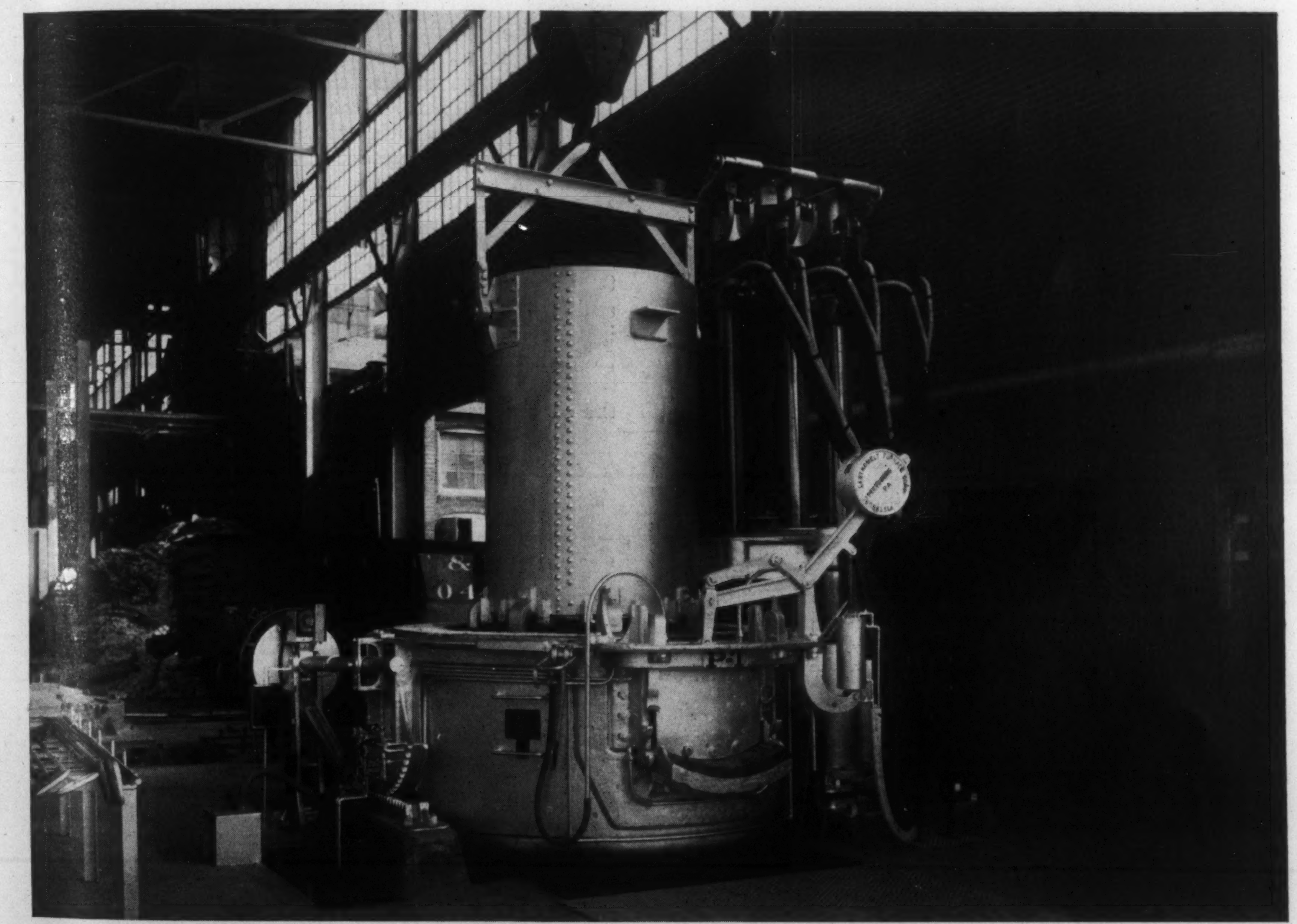
One might possibly melt scrap steel, mixed with enough coke to lower its melting point so that the furnace can handle it, in a rotary pulverized coal furnace, and produce metal of say 2.5 percent C instead of that of say 3 percent C, from the cupola, since it is alleged that the rotary coal furnaces melt gray iron at an operating cost not far above that of the cupola, and the lower the carbon, the less oreing down need be done in the electric. However, the cost of a rotary furnace is so much above that of a cupola that, when amortization is taken into account, it is difficult to see how the rotary furnace could compete in intermittent operation, especially since, for the sake of its silica lining, it must be kept hot when idle.

The hot metal cupola duplexing process must obviously be carried out on a basic hearth, since the high iron oxide slag would too rapidly attack an acid lining.

The process being relatively untried, there are several points that need experimental demonstration before the process can be appraised.

Removal of the Sulphur

The cupola metal will pick up sulphur from the coke and this must be removed, either by soda ash treatment in a fore-hearth or a transfer ladle, or by a basic, reducing, slag in the electric. The cupola metal could be run into the electric and desulphurized under a lime slag just as in the duplexing of cast iron, that slag removed and oreing down then carried out, or the carbon could first be removed by oreing down and the metal finished under a strongly basic, reducing slag, which would both remove sulphur and deoxidize the metal. Since a major aim is to use as little power as possible and hence to keep the metal in the electric as short a time as possible, it appears that main dependence should be placed on the soda ash method to control the sulphur content.



Installation of an Electric Arc Furnace for a Large Steel Foundry. The furnace is being loaded with a drop bottom bucket. (Courtesy of Pittsburgh Lectromelt Furnace Corp.)

The oreing down process involves a "boil," and it is necessary to know how fast the iron oxide may be added without throwing the slag out of the furnace, as Hall pointed out. After oreing down the metal is in a highly oxidized condition and without considerable experience one will be somewhat in doubt as to the oxide content corresponding to a given carbon content as shown by preliminary analysis and will be somewhat uncertain as to the amount of deoxidizers and recarburizer to add in order to meet close chemical specifications. Finally, in order to evaluate the economic position of the process, it must be known how much power is required and how long it takes to make a heat.

Rate of Oreing Down

The permissible rate of oreing down was studied in the laboratory, first by small melts in a high frequency induction furnace, and then by 125-lb. melts in a rocking indirect arc furnace. It was found that ore or mill scale could be safely added to the slag at a surprisingly rapid rate without producing a violent boil. While it was not expected that the process would be feasible on an acid hearth, it was tried in both the induction and the rocking furnaces, and found to attack the acid lining too badly. Also the action was slowed down too much in the presence of the voluminous slag. In order to keep the slag volume at a minimum, it appears that the iron oxide should be supplied as high grade ore, with the minimum of silica, or, still better, as mill scale.

In either furnace, metal of 3 percent C could be brought down to 0.05 to 0.10 percent C in about 40 min. by the addition of slightly over the theoretical amount of iron oxide. Recarburization was a bit uncertain unless the oxide was first removed by silicon and aluminum, but the recovery of carbon was uniform when the metal had previously been deoxidized by metallic deoxidizers.

Trials in a 4-Ton Basic Electric

No useful idea of the power requirements could be gained from these small melts, so the next step was to try a series of heats in a 4-ton basic direct arc furnace, through the courtesy of the Marion Steam Shovel Co. The first heat was made without any attempt to desulphurize, primarily to see how the oreing down process worked with the arc furnace slag, the oxide (mill scale) being added very cautiously. In later heats the cupola metal was treated with soda ash in the ladle, and an attempt made to speed up the oreing down.

In all these tests 7000 lbs. of steel angles, mill scrap from rerolling of rails, etc., estimated to run 0.40 to 0.70 percent C, was charged in three charges into a 54-in. cupola on a 2200-lb coke bed, with 325 lbs. of coke between charges. Charging was started 10 to 15 min. after the bed was lighted and the wind put on 30 to 40 min. later. The metal was tapped about 40 to 50 min. later into a 6-ton ladle. Metal temperature at tapping ranged from 2600 to 2700 deg. F. and the metal analyzed from 3.15 to 3.50 percent C, with about 0.14 to 0.17 percent S. When 20 lbs. of soda ash was added to the cupola charge and 60 lbs. to the ladle the sulphur was reduced to 0.05 to 0.07 percent. Since no fore-hearth was available the treatment had to be carried out in the ladle and could not be carried as far as one would like because of loss in temperature.

By the time the metal was transferred to the electric it had fallen to 2400 deg. when the sulphur was reduced to 0.05 percent and to 2550 deg. F. when it was taken down only to 0.07 percent. It would be better to tap into a heated fore-hearth in which the sulphur could be reduced without so much loss in temperature, and if the metal is allowed to run out into the fore-hearth instead of being held in contact with the coke, lower carbon hot metal would be produced.

First Heat—No Sulphur Removed

In the first heat the cupola metal with 3.32 percent C was charged into the electric at a temperature of 2460 deg. while the furnace itself had been preheated to 2700 deg., i. e. it was not at full operating temperature. A slag was formed by the addition of 80 lbs. of lime and the furnace put on the low tap. Mill scale was then cautiously added. The slag foamed somewhat but the foaming was reduced with each fresh addition of scale, as if a mildly vigorous evolution of gas caused more foaming than a very lively action did. Scale additions, of 400 to 500-lb. lots at first, and later of 250-lb. lots, were made for a period of 3 hrs. (an unnecessarily slow rate of oreing down) and fracture tests taken from time to time. After a total of 2065 lbs. scale had been added, a preliminary analysis showed 0.12 percent C, 0.16 percent Mn.

The slag was then run off and the bath killed with 3 lbs. of aluminum held 15 min. and recarburized and finished with 315 lbs. of pig iron, 47 lbs. of ferromanganese and 75 lbs. of ferrosilicon. No attempt was made to form a carbide slag. The metal was poured at 2950 deg. It contained 0.32 C, 0.72 Mn, 0.26 Si, 0.042 P and, since no attempt was made to desulphurize, 0.14 percent S.

The heat took about 4 hrs. and used 2340 k. w. h. The charge figures to:

	7000	lbs. steel scrap
2065 x 70%	1445	lbs. iron from scale
	315	lbs. pig
	47	lbs. FeMn
	70	lbs. FeSi
	8877	

Allowing for metal loss, the power consumption was at the rate of about 550 k. w. h. per ton. With the furnace at this degree of preheat, a cold melt, in the regular plant practice, would have required nearly 700 k. w. h. per ton.

Second Trial—Sulphur Reduced with Soda Ash

The next run was made with 7,000 lbs. of cupola metal of 3.47 percent C which had been soda ash treated and the sulphur reduced to 0.05 percent. The cupola tapped at 2700 deg. and the metal was charged to the electric at 2400 deg., with the furnace preheated as before; 75 lbs. of scale was placed on the furnace hearth and the cupola metal poured on it. The arc was started and 1260 lbs. of scale added in the first ½ hr., then allowed to work for 20 min. when a preliminary analysis showed 1.83 percent C. After another 20 min., 560 lbs. more scale was added, the oxidizing slag poured off and another analysis taken which showed 0.31 C and 0.13 percent Mn.

A white slag was built up from 170 lbs. of lime, 30 lbs. of sand, 60 lbs. of fluorspar and 10 lbs. of carbon and allowed to act for 25 min. A sample then analyzed 0.09 C, 0.23 percent Mn showing that a carbon drop had gone on with removal of oxygen, followed by reduction of manganese from the slag.

In this process there was evidently a pick up of carbon from the carbon on the slag while the analysis was being made. Recarburization was done by 370 lbs. of pig iron being calculated on the basis of the 0.09 percent C figure and, 411 lbs. of ferromanganese and 70 lbs. of ferrosilicon were added. The heat finished too high in carbon, analysing 0.47 C, 0.82 Mn, 0.46 Si, 0.044 P and 0.034 percent S. It was tapped at 2920 deg., took 2 hrs.. 55 min. and used 2110 k. w. h. the charge was:

	7000	lbs. steel scrap
1860 x 70%	1302	lbs. iron from scale
	370	pig
	41	FeMn
	70	FeSi
	8783	

There was 8,520 lbs. recovered, i. e. the metal loss was about 3 percent. The power consumption figures to 495 k. w. h. per ton.

Third Trial—Larger Use of Mill Scale

The next heat tapped metal of 3.16 C, 0.21 Si, 0.21 Mn, 0.06 P and 0.17 percent S at 2650 deg. from the cupola. By soda ash treatment the sulphur was reduced only to 0.066 percent. It was charged to the electric at 2550 deg. The electric was at normal operating temperature, after a previous heat; 280 lbs. scale was placed in the bottom of the furnace and the metal poured on it. After the arc had been on 10 min., 280 lbs. more scale was added and 6 min. thereafter another 280 lbs., then at 7 and 11-min. intervals two doses of 140 lbs. and 9 min. later 280 lbs. more. A total of 1400 lbs. scale was thus added in the first 43 min.

In another 12 min. a violent boil occurred, some slag coming out of the door. Apparently the scale was added a little too fast or too much put on the bottom, more probably the latter. The metal was rather cold at this stage and considerable time was lost in getting the chilled slag and metal off the furnace sides. It will probably be wiser to heat the cupola metal in the electric to a higher temperature before starting to ore down.

A preliminary analysis taken 47 min. after the last scale addition showed 0.52 C, 0.12 percent Mn; 29 min. later the metal appeared low enough in carbon by fracture test so the slag was thinned with a shovel of fluorspar and poured off, the metal killed with 2.5 lbs. of Al and another sample sent for analysis. The metal showed 0.27 C, 0.22 percent Mn.

Additions of 70 lbs. of pig, 32 lbs. of ferromanganese, 70 lbs. of ferrosilicon were made and the metal poured at 3000 deg. F. The heat took 2 hrs. 24 min. and 1630 k. w. h. The charge was:

	7000 lbs.	steel scrap
1400 x 70%	980 lbs.	iron from scale
	70 lbs.	pig
	32 lbs.	FeMn
	70 lbs.	FeSi
	8152	

Taking the metal recovered as 4 tons, the power consumption was 408 k. w. h. per ton.

There was a delay of a full half hour, due to the slag trouble from the too violent boil, which seemed caused by putting too much scale on the hearth. Save for the loss of time and temperature during that period, the heat would not have taken over 2 hrs. and the power consumption would have been well below 375 k. w. h. per ton.

The heat finished 0.34 C, 0.77 Mn, 0.48 Si, 0.045 P and 0.07 percent S, the high sulphur being due to the fact that the cupola tap was exceptionally high in sulphur and sufficient soda ash and time were not allowed. The steel, double normalized from 1700 and 1620 deg. F. and drawn at 1250 deg. F. gave 81,000 lbs. per sq. in. tensile strength, 55,000 lbs. per sq. in. yield strength, 25.5 percent elongation, 35.5 percent reduction of area, which, considering the carbon and sulphur content, are normal values.

General Results

It appears that with a heated fore-hearth for the cupola so that lower carbon and lower sulphur can be obtained and the hot metal temperature kept a bit higher, and with a small rotary oil or gas-fired furnace for preheating the mill scale or ore, one should be able, with the furnace at average operating temperature at the start, to get out a 4-ton heat in not over 2 hrs. and at not over 350 k. w. h. per ton. This compares with around 4 hrs. and about 650 k. w. h. per ton in the regular plant practice on cold melts.

A Cupola Ready for Tapping.

Mr. Batty suggests, on a 3-ton charge, adding the cupola metal in successive lots of 1½, 1 and ½ tons, interspersed with additions of hot ore (preheated by waste gases from a heated fore-hearth), believing that in such practice the carbon can be eliminated in 1 hr. If so, the energy required should fall below the estimate of 350 k. w. h. per ton made on the basis of the above experiments.

Tentative Cost Data

Since Hall predicted that the process would be cheaper than cold melting, it is of interest to see what tentative cost figures are secured on the basis of the preliminary experiments recorded above. Obviously, accurate and dependable cost data can only be secured by more extensive tests or by regular production. Any such process generally smooths out as experience is gained with it but, making no allowance for probable refinements, a cost calculation has been made on what is thought to be a conservative basis. This is, however, necessarily only of a tentative nature. It does indicate that, since the process works, it offers sufficient economic promise to justify bringing it to the attention of steel foundries.

For purposes of calculation we may assume that, aside from the heads and gates which revolve in the plant, the raw materials will cost:

$15.00 per ton for heavy melting scrap.
10.00 per ton for shoveling turnings.
3.50 per ton for mill scale—(Equivalent to $5 per ton contained iron).
20.00 per ton for low phosphorus pig for recarburizing,

and that in cold melting at 650 k. w. h. per ton the furnace conversion costs aside from power are, per ton of melt, refractories $1.00, electrodes $1.25, labor $2.25, amortization $1.50 or a total of $6.00 per ton.

In the tests the refractories and electrodes did not appear to be used up more rapidly than in the use of an equal number of kilowatt hours in cold melting, though in the long run one would expect them to be slightly more attacked. The same crew can handle the furnace. The furnace output is roughly in inverse proportion to the kilowatt hours needed. If the refractory, electrode, labor and amortization charges are cut in the proportion of 650 to 350 k. w. h. these would come to about $3.25 per ton instead of $6.00. Since one would need the results of extended operation to be sure about electrode and refractory life, we will set this figure at $4.00.

Cupola conversion costs including coke, refractories, labor and amortization, are known to be approximately $3.00 per ton in good normal operation. The need of a fore-hearth, and the coke requirements for melting all-steel will raise this somewhat, but $4.00 should be ample allowance.

We may then figure the costs as follows—figuring on a wholly purchased charge:

Electric cold melt:

Charge: 1200 lbs. shovelling turnings..	$ 6.00	(includes metal loss)
1000 lbs. melting scrap	7.50	
Ferro alloys and fluxes	1.00	
Electric furnace refractories, electrodes, labor and amortization	6.00	
Power, 650 k.w.h. @ 1c	6.50	
	$27.00	

Unless a top-charging furnace is available, turnings might not be used, in which case this figure would rise to about $28.50.

Hot metal practice:

Charge: 1800 lbs. heavy melting scrap (including melting losses)	$13.50
350 lbs. mill scale (245 lbs. iron)	0.61
10 lbs. pig iron	0.10
Cupola conversion on 1800 lbs.	3.60
Electric furnace refractories, electrodes labor, amortization	4.00
Extra for soda ash, aluminum, fuel for heating fore-hearth, scale, transfer ladle, etc. (estimated)	0.69
Ferroalloys and fluxes	1.00
Power, 350 k.w.h. @ 1c	3.50
	$27.00

Thus the duplexing process bids fair at least to break even with cold melting under the conditions most advantageous for a cold melt. Where melting stock without borings is used, the duplexing process would show an advantage of $1.50 per ton.

The process shows up to still better advantage when effective power costs are above 1c per k. w. h. Thus, if power costs 1½c per k. w. h., the totals come out:

Electric cold melt $30.25 with turnings, $31.75 with melting stock,
Hot metal practice $28.75

or an advantage of $1.50 to $3.00 per ton depending on whether turnings are used in the cold melt.

There is sufficient promise for the hot metal practice to justify Hall's prediction of 1914 that it was probable that a saving could be made over cold melting.

Other Considerations

There are other points of interest not brought out in the calculation above. In full production, the electric furnace will make nearly twice as much steel with hot metal charges as it will in cold melting. The fluctuating arc and the high momentary demand of the melting-down period of cold melting are avoided. The low tap can be used throughout. Hence the maximum demand will be lowered, and if desired, a transformer of smaller capacity than is needed for cold melting may be used. With the lower maximum demand, it might work out that hot metal practice in the daytime would be almost as cheap as cold melting at night.

To secure these advantages it is necessary to provide a cupola, a transfer ladle, and a basic lining for the electric. It will be essential to have a fore-hearth, preferably a heated one, and arrangements should be made for easy transfer of the cupola metal to the electric. A fuel-fired furnace for preheating the ore or scale should also be provided and conveniently located in reference to the electric.

What difficulties there are in the process appear to reside in the cupola melting rather than the electric end. The cupola should be run to produce metal as hot as possible and as low in carbon as possible, (a hot-blast cupola might be advisable) and adequate soda ash treatment needs to be provided for, so as to hold down the sulphur. When these things are satisfactorily accomplished, the hot metal process should involve no particular difficulties for a skilled electric melter. The added cost for equipment is at a minimum compared with other duplexing methods.

Where electric steel furnaces are idle because of power costs or where the installation of a new electric is being postponed because of fear of power costs in slack times, the hot metal process offers possibilities for minimizing the demand and the energy required and should make more widely available to the steel foundryman the convenience and flexibility of the electric furnace.

SILVER-COPPER-SILICON ALLOYS

Notes on the Aging of Silver-Rich Ones

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IN THE PAST considerable work has been done upon the binary system of silver and copper. Less information is available on the ternary alloys. It is the object of this paper to add information concerning physical and electrical properties during aging of one of the ternary alloys of silver.

In the binary system, good electrical properties and good physical properties may go together. In the ternary system with silicon, a sacrifice of some of these good properties is made upon the addition of the third element.

These alloys were all melted, and then remelted in an induction furnace in order to insure uniformity. The test pieces for aging were 1 in. by ½ in. by ⅛ in., those for electrical conductivity 0.125 in. in diameter, the latter being drawn through diamond dies to insure a uniform diameter. Throughout this investigation coin silver was used as a means of comparison

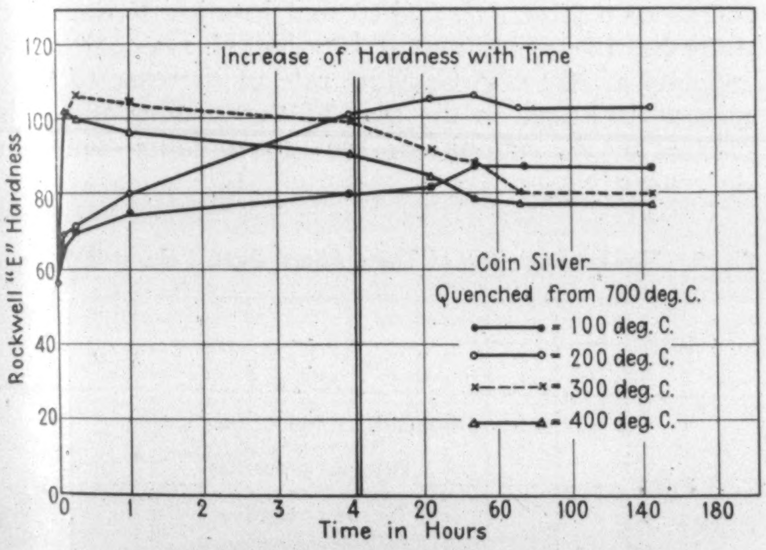


Fig. 1. Increase of Hardness with Time for Coin Silver.

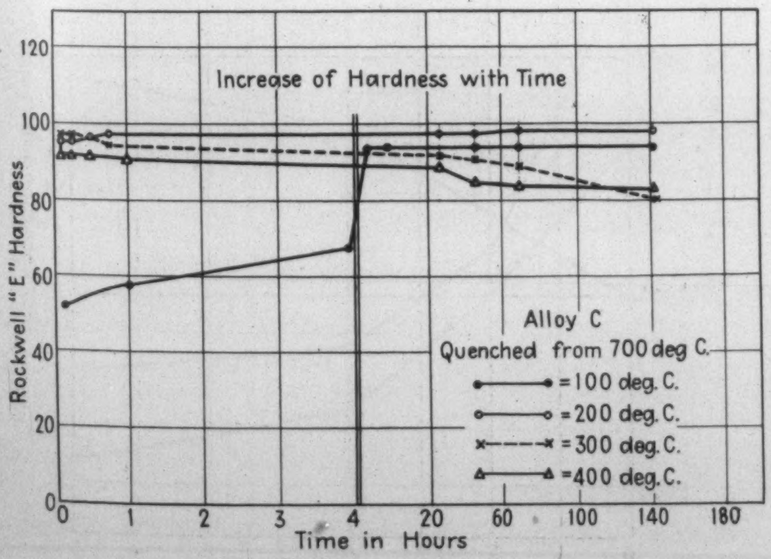


Fig. 2. Increase of Hardness with Time for Alloys C.

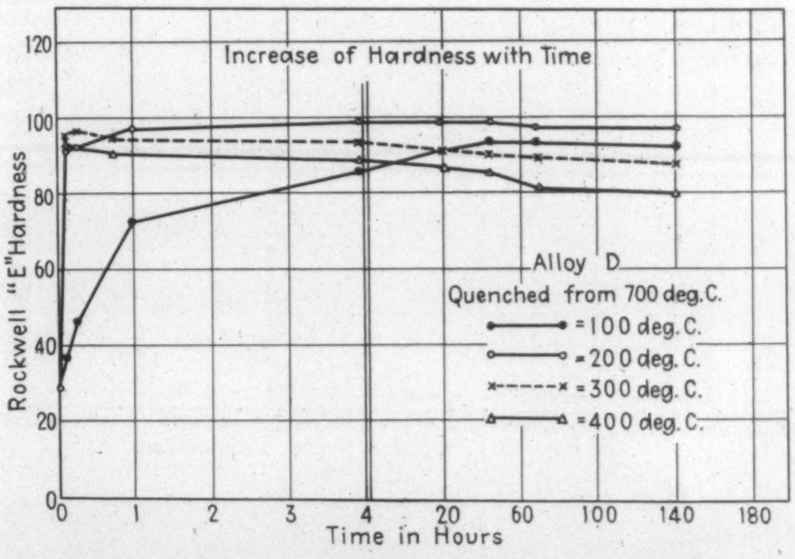


Fig. 3. Increase of Hardness with Time for Alloy D.

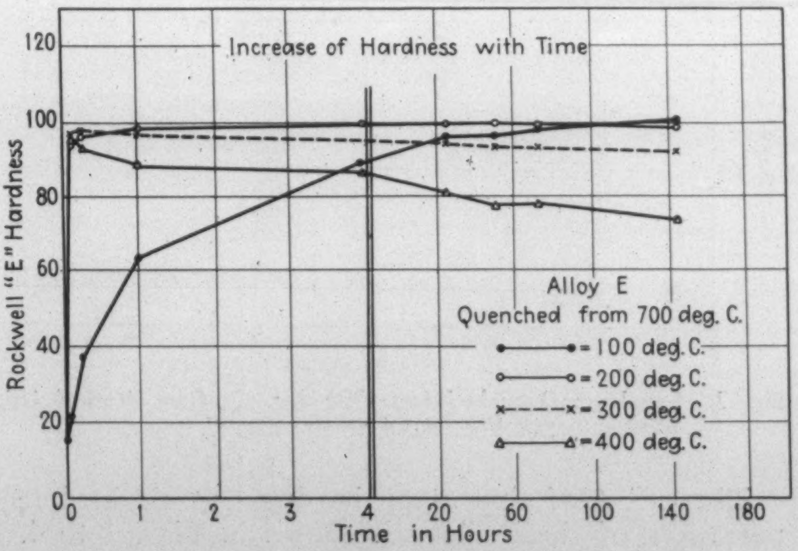


Fig. 4. Increase of Hardness with Time for Alloy E.

for hardness and conductivity. The pure silver used in making up the alloys was taken as having 100 per cent conductivity. The analyses of the alloys are as follows:

Alloy	*Silver,** %	*Copper,* %	*Silicon,* %
Coin Silver	90.00	10.00	0.00
Alloy C	92.14	6.99	0.87
Alloy D	96.52	3.16	0.32
Alloy E	98.00	1.86	0.14

*Silver by difference.

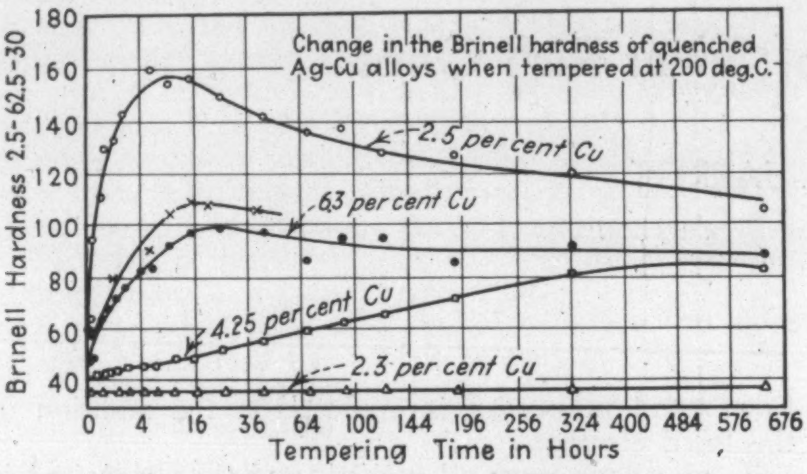


Fig. 5. Change in the Brinell Hardness of Quenched Ag-Cu Alloys when Tempered at 200 deg. C. (Ageew, Hanson and Sacks. *Zeitschrift für Physik*, Vol. 66, 1930, page 350.)

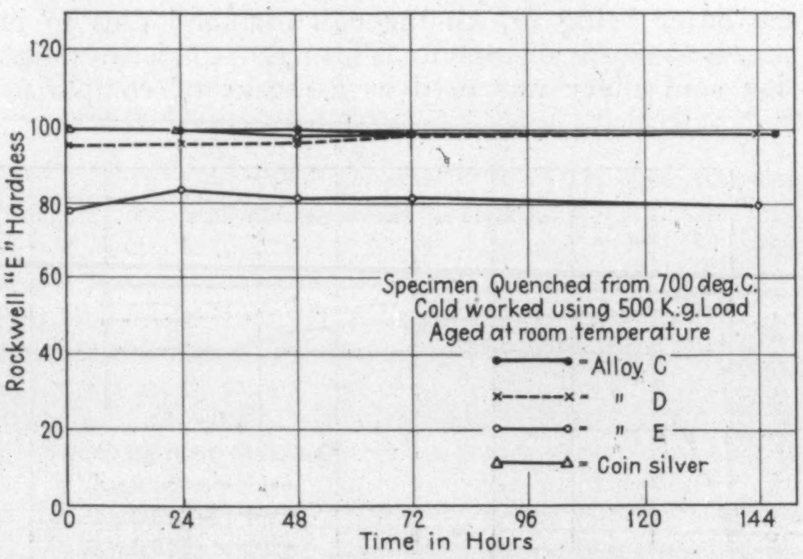


Fig. 6. Specimen Quenched from 700 deg. C., Cold Worked Using 500 k.g. Load, Aged at Room Temperature.

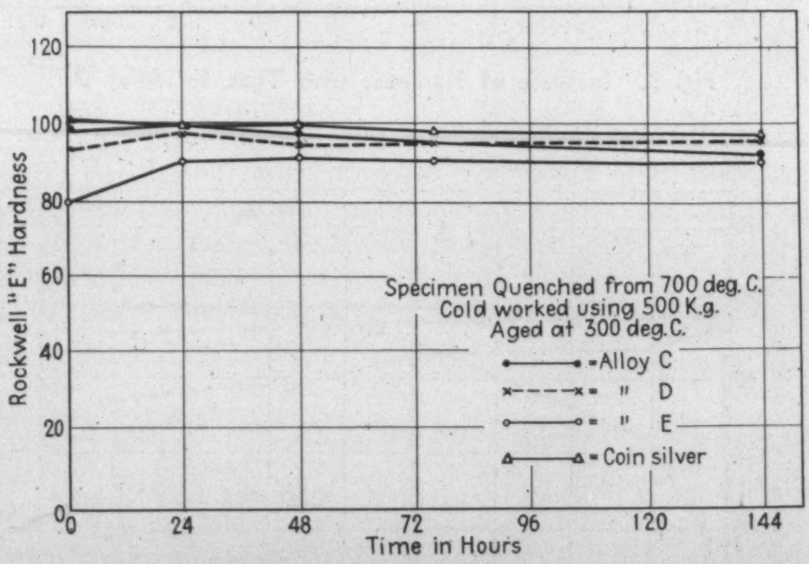


Fig. 7. Specimen Quenched from 700 deg. C., Cold Worked Using 500 k.g., Aged at 300 deg. C.

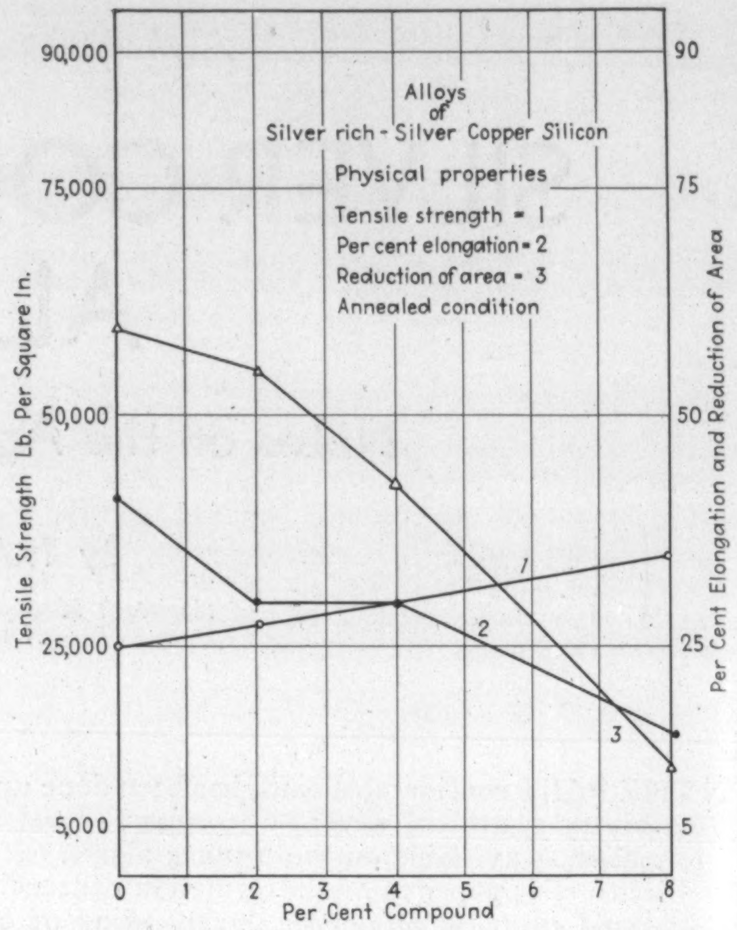
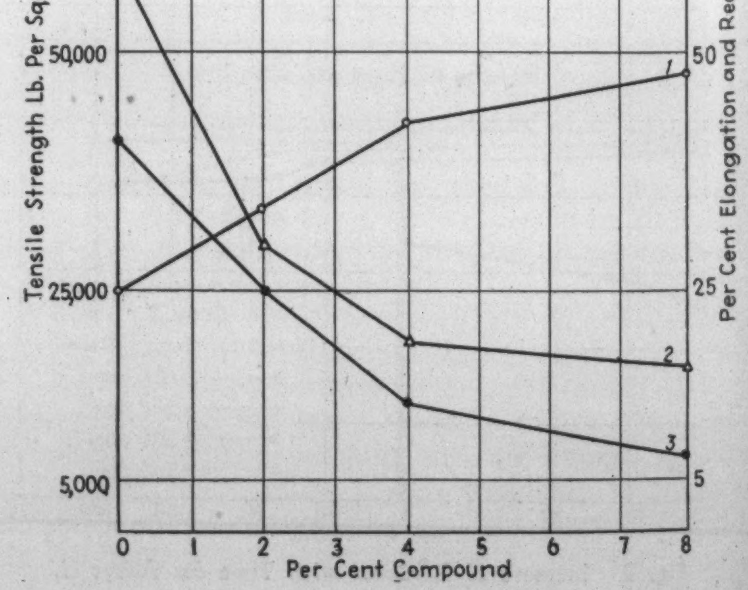


Fig. 8. Physical Properties of These Alloys in Annealed Condition.

The effect of time upon hardness at elevated temperatures of these alloys is shown in Figs. 1 to 4. It will be observed from Fig. 1 that at 100 deg. C. the increase of hardness with time is very slow and that the maximum hardness does not approach that of the other temperatures. This fact is very noticeable in the coin silver, C, and D, but in alloy E the maximum hardness obtained at 100 deg. C. is equal to that reached at 200 deg. C. The rate of increase of hardness at 100 deg., in the case of the ternary alloys, increases as the amount of the intermetallic compound decreases.

Fig. 9. Physical Properties of These Alloys, Aged 1 Hr. at 300 deg. C.



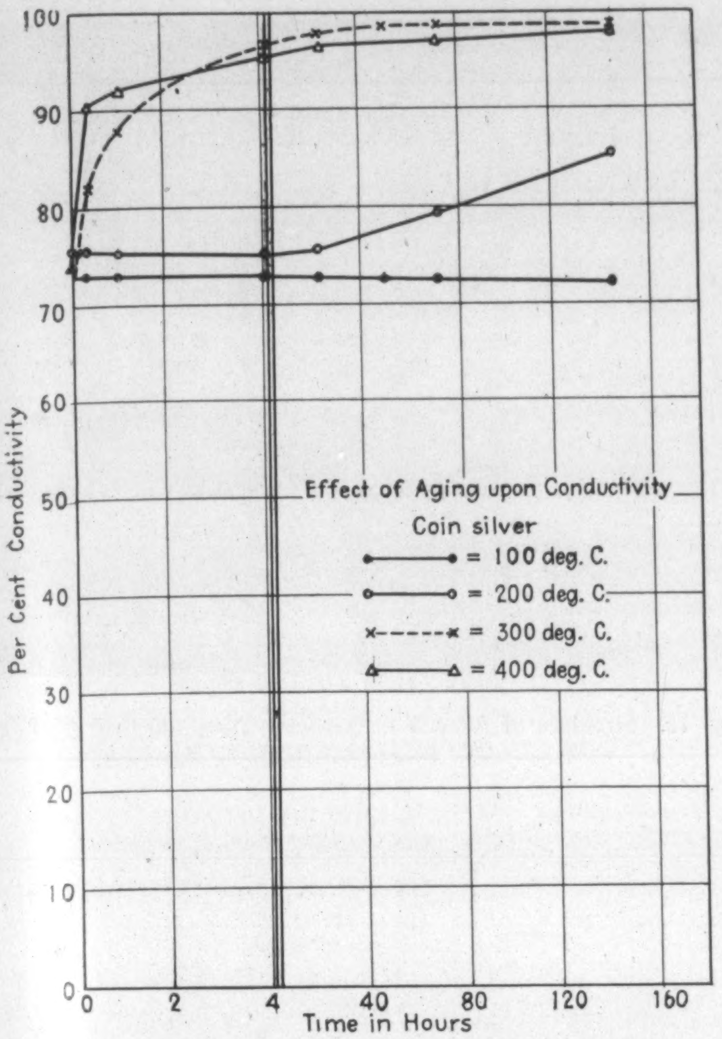
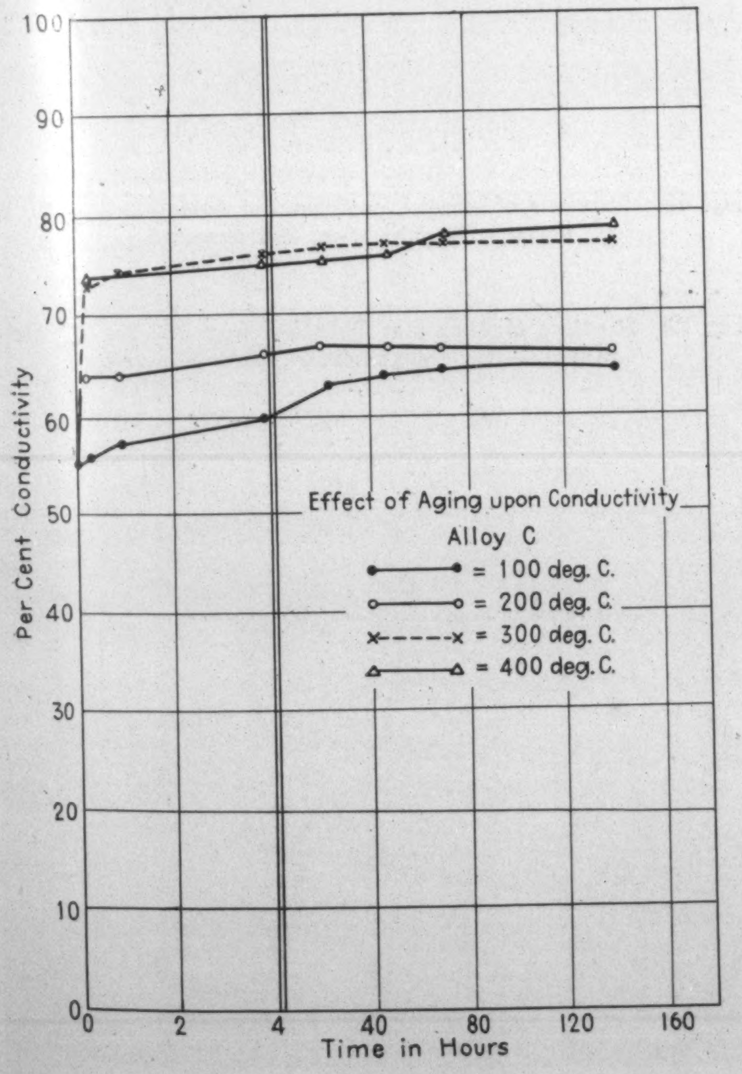


Fig. 10. Effect of Aging Upon Conductivity—Coin Silver.

Fig. 11. Effect of Aging upon Conductivity—Alloy C.



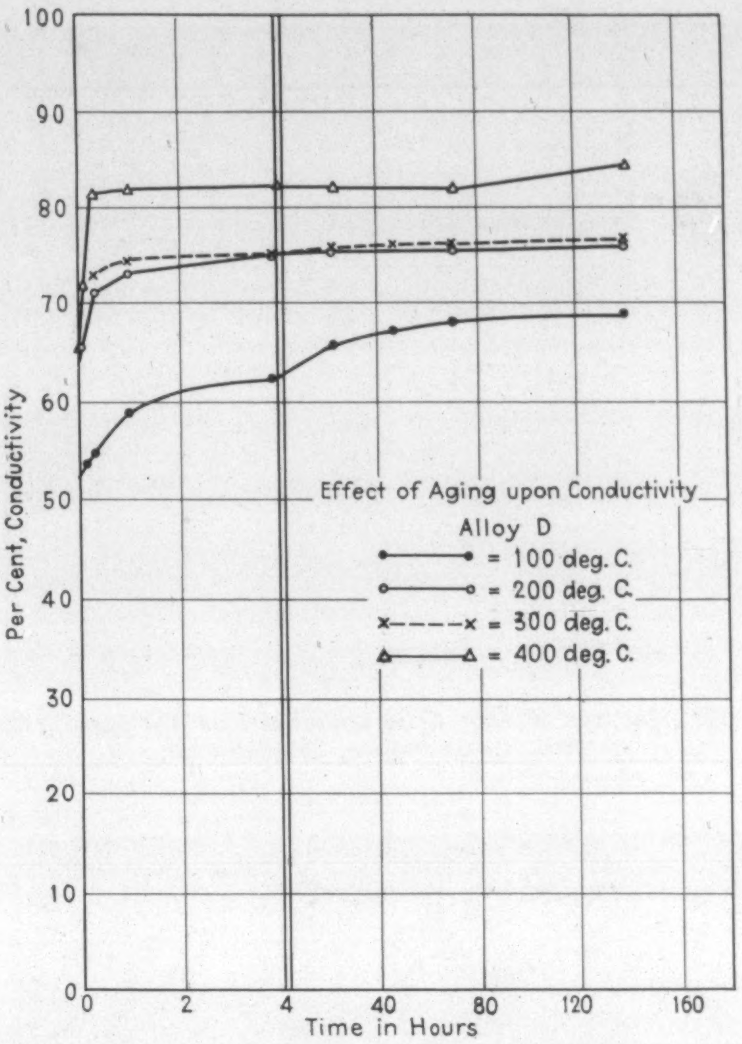
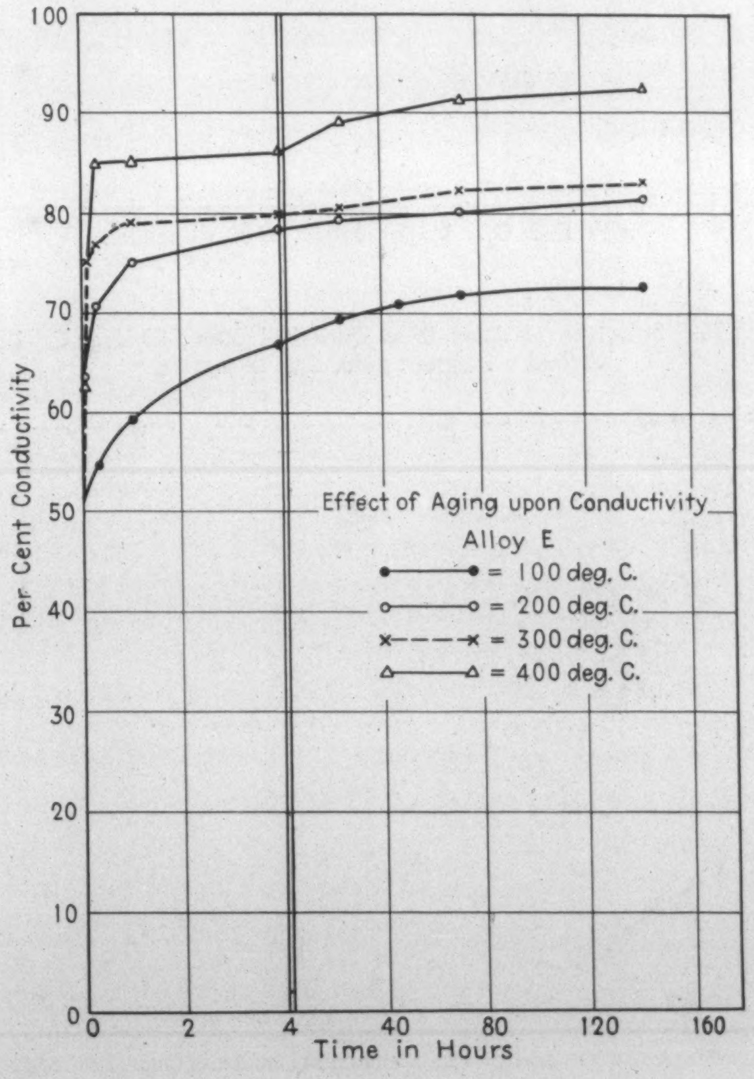


Fig. 12. Effect of Aging upon Conductivity—Alloy D.

Fig. 13. Effect of Aging upon Conductivity—Alloy E.



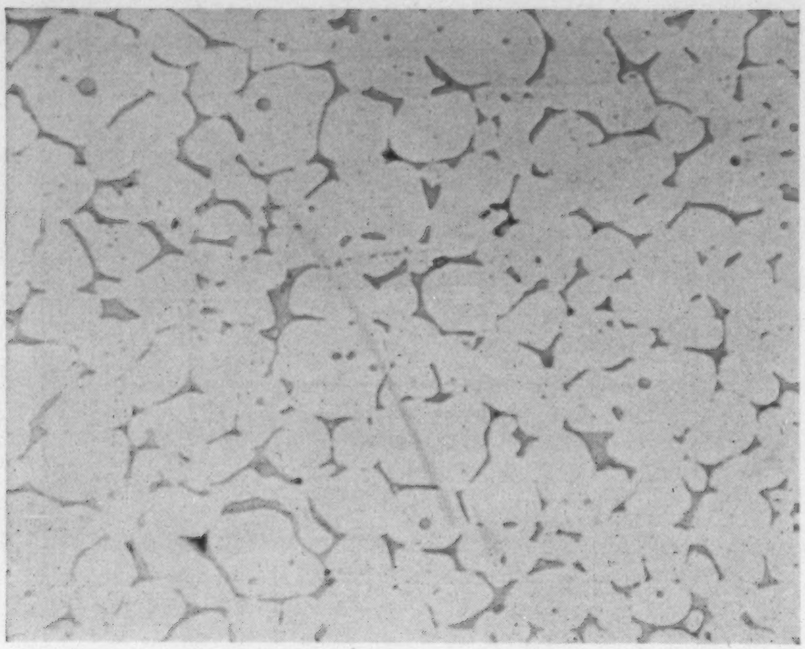


Fig. 14. Structure of Alloy C, as Quenched from 700 deg. C., Unetched. Magnification, 250 diameters.

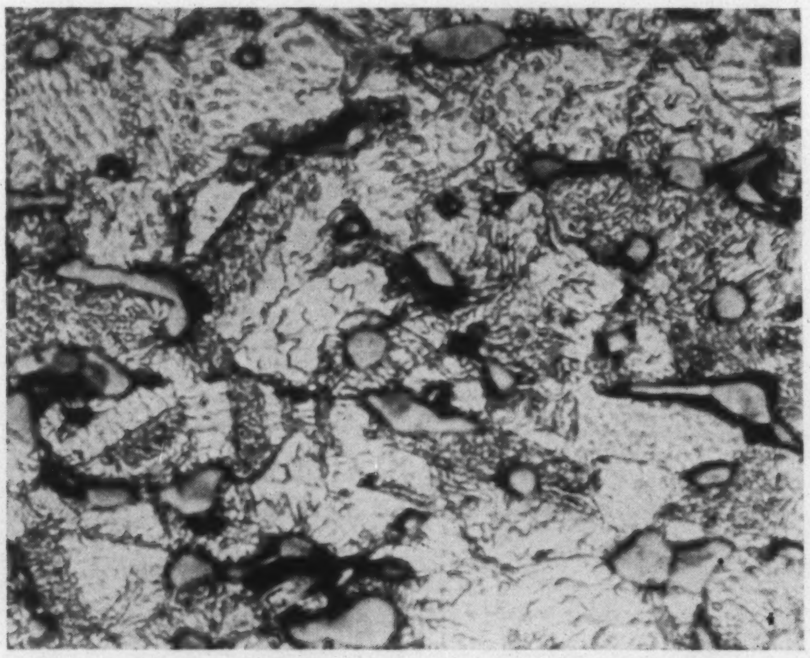
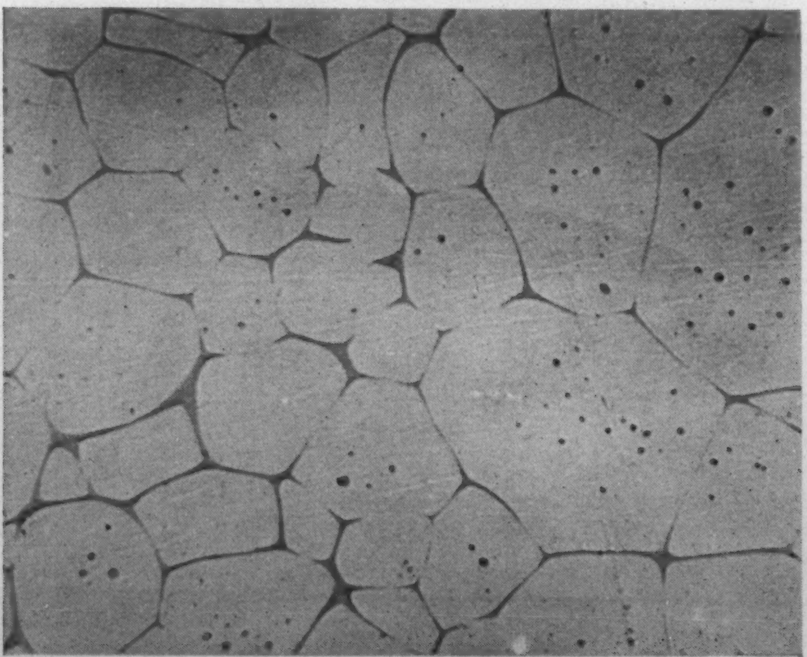


Fig. 15. Structure of Alloy C as Quenched from 700 deg. C., Etched with $K_2Cr_2O_7$. Magnification, 1000 diameters.

Fig. 16. Structure of Alloy D as Quenched from 700 deg. C., Unetched. Magnification, 250 diameters.



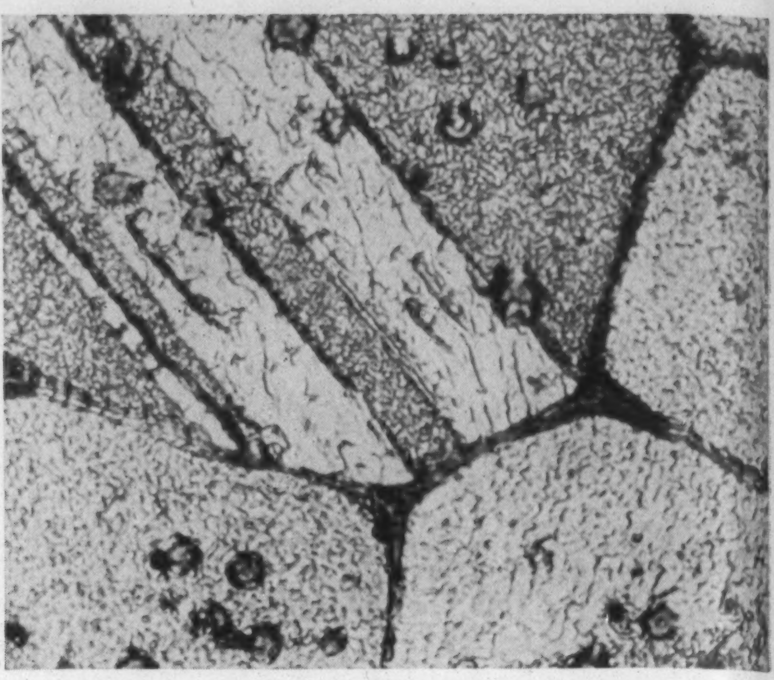


Fig. 17. Structure of Alloy D as Quenched from 700 deg. C., Etched with $K_2Cr_2O_7$. Magnification, 1000 diameters.

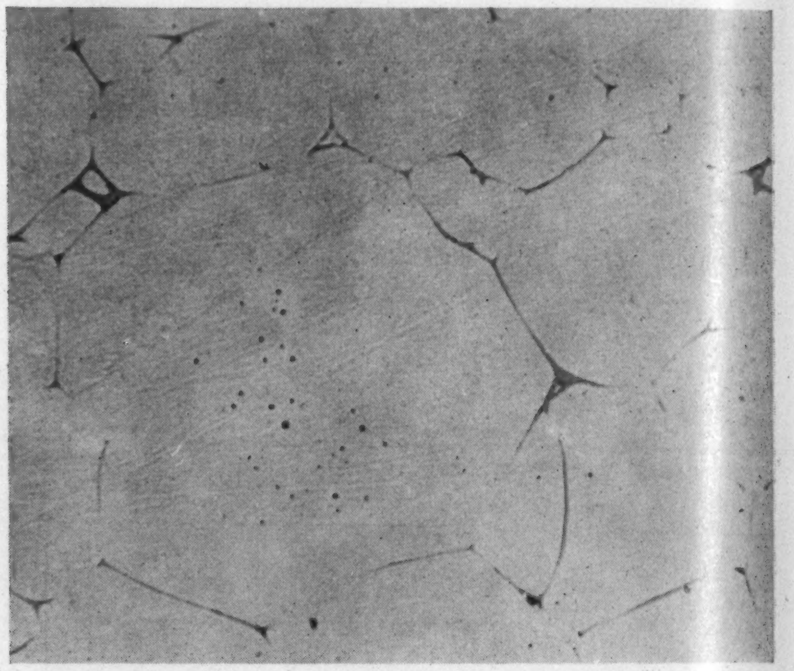
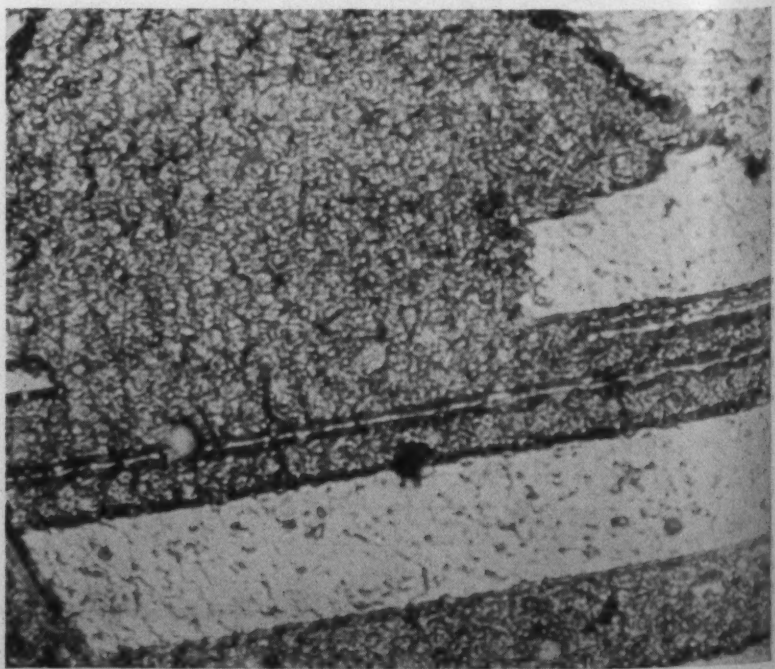


Fig. 18. Structure of Alloy E as Quenched from 700 deg. C., Unetched. Magnification, 250 diameters.

Fig. 19. Structure of Alloy E as Quenched from 700 deg. C., Etched with $K_2CR_2O_7$. Magnification, 1000 diameters.



In all cases of these silver-rich ternary alloys the maximum retained hardness occurs at 200 deg. C. Although the rate of increase of hardness is not as rapid at 200 deg., as in the case of higher temperatures, the alloys aged at 200 deg. C. retain their hardness after a period of 144 hrs. This does not hold true with temperatures above 200 deg. C.

In the case of temperatures of 300 and 400 deg. C. the time at which maximum hardness occurs is about the same. The maximum hardness obtainable in a very short period of time takes place at 300 and not at 400 deg. as might be expected. It is also noticed that the decrease in hardness with time is greater at 400 deg. and the final decrease of hardness also occurs at this temperature.

An important point is that the initial hardness after quenching is lower with decreasing amounts of compound present. The actual final hardness obtained is about the same in all cases of these ternary alloys. This may be explained in part that some of the aging takes place in the quenching bath, as in alloys C and D, while there was not enough excess constituent in alloy E.

The question might arise that the aging is not due to an intermetallic compound such as Cu_3Si, but rather to copper since coin silver ages without silicon being present. In silicon-free alloys of lower copper content, it can be seen from Fig. 5, that as the amount of copper decreases, the rate of increase of hardness becomes less. In the case of a 2 per cent silver-copper alloy no increase of hardness is noticed, while in alloy E, which contains 2 per cent of the intermetallic compound, a hardness equal to that of coin silver is obtained. This seems to indicate that the hardness produced in these silver-rich alloys is due to the precipitation of this intermetallic compound.

Figs. 6 and 7 show the effects of cold work on the alloys when aged at room and elevated temperatures. The Brinell method, using a 500-kg. load was used to produce the desired amount of cold work. Although in some systems aging does occur after cold work, either at room or at elevated temperatures, no appreciable change takes place in this ternary system.

In determining the tensile properties of these alloys a test bar with a cross sectional area of 0.468 sq. in. and a gage length of 1¼ in. was used. A bar in the fully annealed condition, or one which had been quenched from 700 deg. C. in water, and a bar in the fully aged condition, that had been aged 1 hr. at 300 deg. C. after being quenched in water from 700 deg. C. were used in making the tensile tests. The tensile strength increases with amount of compound while the elongation and reduction of area decrease. See Figs 8 and 9.

For the electrical conductivity tests, a Kelvin double bridge was employed and test pieces of 0.125 in. in diameter and 6 in. in length were used. The specimens were treated the same as those used in the aging test, in that they were all made age hardenable by quenching from 700 deg. C. in water and aged at 100, 200, 300 and 400 deg. C. The results are shown in Figs. 10 to 13. In all cases the conductivity increases as time and temperature of aging increase.

In coin silver no increase of conductivity takes place at 100 deg. and not until after some 40 hrs. at 200 deg. C. does any noticeable change occur. In the other alloys, there is a slow increase of conductivity at 100 deg., comparable with the change in hardness. Although the hardness continued to drop with time at the higher temperatures, the conductivity increased. The conductivity increases with temperature as the amount of compound decreases. This corresponds to similar results obtained from aging tests in that the maximum hardness is produced in the alloys where there is the least amount of the intermetallic compound.

In the photomicrographs shown in Figs. 14, 16 and 18, in the unetched condition, considerable amounts of the compound appear. It was first thought that the alloy itself or the compound was actually molten when quenched, due to the continuous network of the compound present. After further investigation this proved not to be the case. In the as-cast condition it was noticed that large quantities of the compound were present, and in all probability it was impossible to get this excess back into complete solution. In view of the fact that there is still an excess of the compound present, the alloys upon heat treatment showed great increases in hardness and electrical conductivity.

The same samples are shown in the etched condition, Figs. 15, 17 and 19, and although they are heavily etched, they do not show any actual further precipitation after aging or slow cooling. The presence of this compound does reduce the number of twins present, as can be seen from the photomicrographs.

It was impossible to detect any changes in the microstructures after slow cooling or aging, other than is shown in the as-quenched samples.

Note: The work described in this paper is part of a thesis presented in fulfillment of the requirements for the degree of Doctor of Science in Metallurgy from Harvard University.

[An article by Dr. Jarrett of a similar nature on the Silver-Indium Alloys was published in the September issue.—Editor]

A Precision Recording Dilatometer

By R. A. ACKLEY and F. M. WALTERS, Jr.

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This article is a contribution from the Metals Research Laboratory

Abstract: A new high precision recording differential dilatometer is described which records automatically and simultaneously a differential dilatation-temperature curve, obtained photographically, and a time-temperature curve drawn by a pen. The amplification of differential dilatation is 500, the temperature scale 30°C. per inch, and the time scale 20 minutes per inch. Minor changes, which may be made easily, permit recording of differential dilatation-time curves having very open time scales (0.1 to 5 inches per minute have been used). Differential length changes between a specimen and the comparison pieces are measured to within 0.00005 inches, and specimen temperatures are measured to ± 1°C. To maintain this accuracy, frequent attention must be paid to thermometric refinement and calibration; provision is made to keep the temperature gradient in the specimen to very low values (¼°C. or less in a 1-inch specimen). The instrument is equipped so that specimen temperatures may be kept constant within ± 1°C. or raised or lowered at accurately controlled and constant rates of ⅛°, ½°, or 2°C. per minute respectively. A high vacuum (less than ½ micron of mercury) or an inert atmosphere is maintained around the specimen to protect it from changes in composition.

The instrument was designed particularly for determining in a highly precise way the temperatures of transformations in metals and alloys, and also for studying the progress of such transformations at constant temperatures or at constant rates of heating and cooling. It may be used without modification in investigations involving temperatures between 25 and 1100°C. and differential length changes of 0.00005 to 0.01 inches.

THE VOLUME CHANGES IN SOLIDS that are associated with temperature changes may be divided into two classes: (1) the roughly linear expansion (or contraction) usually designated as "thermal expansion," not associated with phase changes, and (2) abrupt expansions (or contractions) associated with phase changes. For the present purposes, the anomalous type of change associated with super-lattice formation is disregarded. The second class of volume changes is either functions of time at constant temperature or functions of the rate of heating and cooling, rather than functions of temperature alone, as in the first class. Volume changes are in general not measured directly, but are inferred from linear changes.

The use of the dilatometer to measure the volume changes of the first type is quite obvious. Some dilatometers designed for this purpose employ micrometer microscopes[1] and interferometers.[2,3,4] Measurements of volume changes of the second class have led to the development of a large variety of instruments. These have been widely used in metallurgical research, owing to their usefulness in the determination of the transformation temperatures at various constant temperatures and various rates of heating and cooling.

The dilatometric method possesses several distinct advantages over other methods: The specimen may be heated or cooled at extremely slow rates and true equilibrium temperatures thus very closely obtained, as will be shown later, a feat quite impossible with thermal analysis; the course of transformation at constant temperature may be studied with accuracy, even when the transformation is rapid, which generally cannot be done by either thermal analysis or microscopic examination; since measurements are made "at temperature" the results are more reliable than those obtained by quenching and micro-examination; the changes in volume accompanying phase changes suffer little or no ambiguity, particularly in contrast with changes in the electrical properties; the measurements are more readily made than those involving the determination of the lattice parameter.

It has been shown that combined dilatometric and X-ray data may be used not only to interpret the meaning of certain complex transformations in alloys of complex systems, but to calculate quantitatively the relative amounts of the phases present at various temperatures.[5] Such an application of the dilatometer is especially important when such information cannot be obtained by the usual methods of thermal analysis and of microscopic inspection of heat-treated specimens, as, for example, in the investigation of many iron-manganese and iron-manganese-carbon alloys.[5,6,7] Since very accurate X-ray and dilatometric data can now be readily obtained, this method of investigation is likely to prove of great value in the future.

In dilatometers for metallurgical use, volume changes associated with phase changes are of primary importance, and those associated with thermal expansion are only of secondary importance. Because of this, certain indeterminant elements have been tolerated in the design of both direct and differential dilatometers, particularly superimposed indeterminant thermal expansions originating in the variable temperature gradient in the member transmitting the dilatation from the hot to the cold zone in the direct dilatometer and in the variable and differing temperature gradients in the like members in the differential dilatometer. This prevents using such dilatometers for the determination of length changes over wide temperature ranges where the temperature gradients may not be assumed constant, but since phase changes occur over relatively short temperature intervals, this is a very minor and unimportant objection in metallurgical dilatometers, particularly in differential dilatometers where one endeavors to create identical environments for the comparison pieces, and where the specimen practically eliminates this factor over short temperature ranges. The thermal arrests which occur at transformation points,—arrests occurring in the specimen but not in the comparison pieces, introduce an unavoidable temperature difference between specimen and comparison piece, but at slow rates this is not great and in no way interferes with the accurate location of temperatures of transformation, as examples will show later. The differential dilatometer has the advantage that a higher magnification of dilatation may be employed without using the excessively large necessary chart for recording direct dilatometers.

The advantages of recording over the laborious and uncertain method of reading are too obvious to be stressed. Typical dilatometers of the optical and mechanical lever amplification types include the Chevenard photographically and mechanically recording differential dilatometers[8, 9] and others developed by Portevin and Chevenard[10], Esser and Oberhoffer[11], Haas[12], and Sato[13]. Other instruments of interest are those of Walters and Gensamer[5], Andrews, Rippon, Miller and Wragg[14], Houghton and Griffiths[15], Prytherch[16], and Goetz, Buchta and Ho[17]. In these dilatometers changes in specimen length are transmitted to the amplification system through silica parts, chosen because of the low coefficient of expression of silica. (The Goetz dilatometer is exceptional in this respect. It has a mirror which is supported between a specimen and silica block and forms part of a combined optical and electrical amplification system.) The method of amplification varies from instrument to instrument. Walters and Gensamer use a dial gage, Andrews and co-workers a hydraulic system, and Houghton and

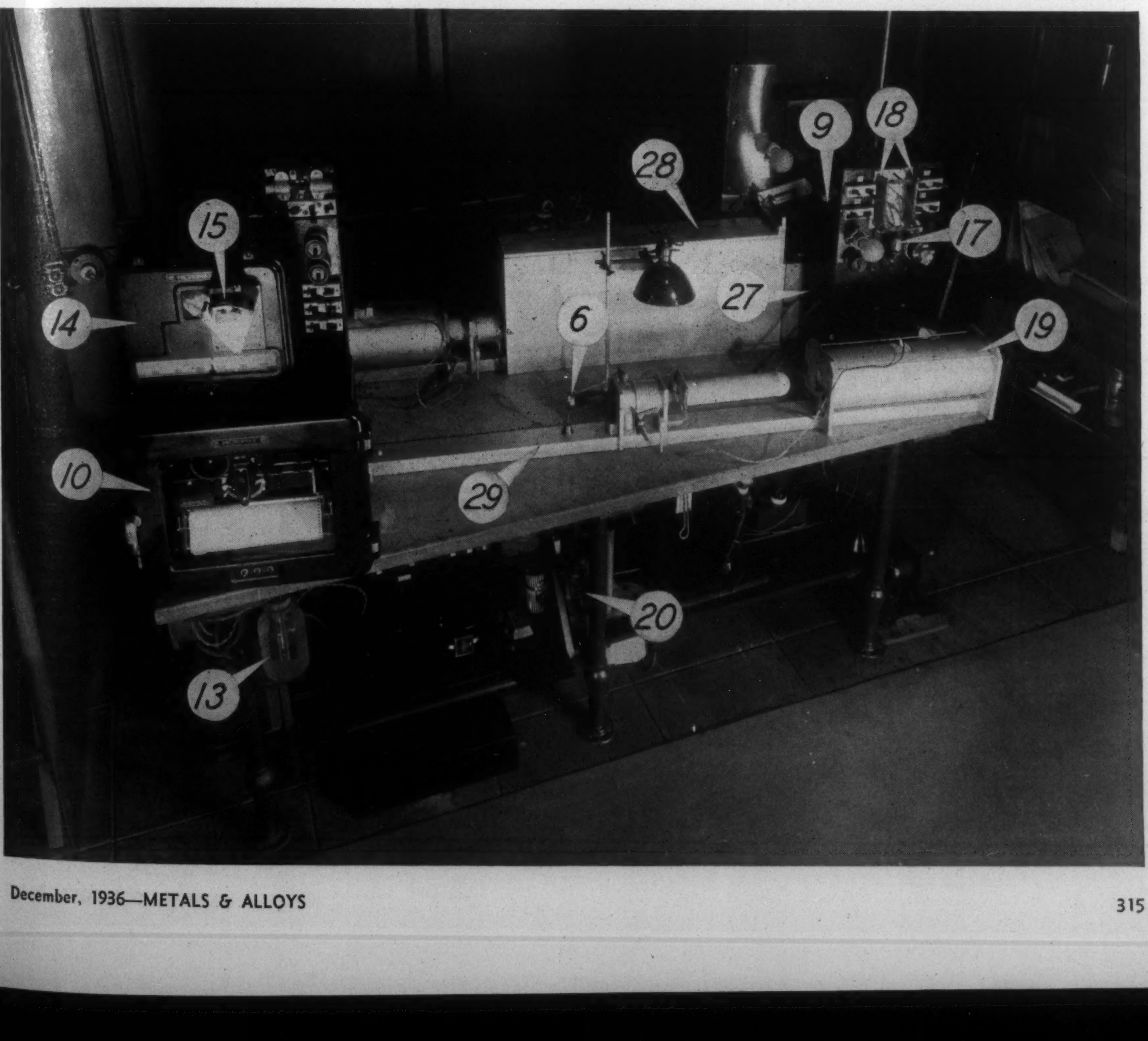


Fig. 1.—Photograph Giving a General View of Two Dilatometers, Each Extending the Full Length of the Table. The one in the background, of which the rear side is seen, is completely assembled, and the one in the foreground, of which the front is seen, has the furnace (19) slid off of the vacuum chamber and the light tight box [(28) of the other dilatometer] removed.

6. Spherical lens.
9. Light source.
10. Micromax recorder.
13. Cold junction equalizer.
14. Micromax controller.
15. Telechron chart movement.
17. Mercury, power relay.
18. Rheostats.
19. Furnace.
20. Differential couple cold junction.
27. Camera box.
28. Light tight box.
29. Structural steel channel.

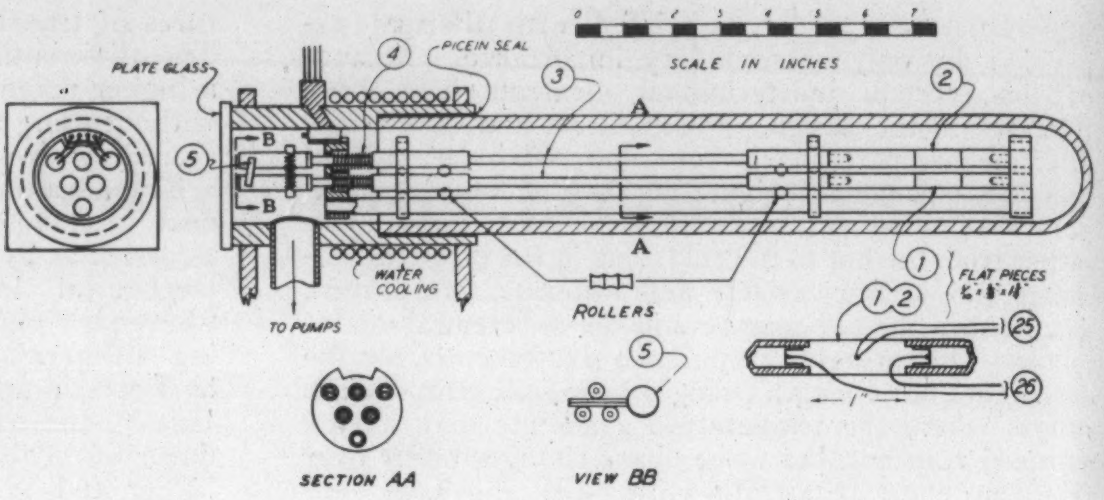


Fig. 3.—Scale Drawing Showing Details of Vacuum Chamber: (1) comparison pieces, (2) specimen, (3) silica rods, (4) springs, (5) stainless steel mirror, (25) thermocouple, (26) differential thermocouple. [(25) and (26) on specimen only.]

Griffiths a combined hydraulic and electrical system. Goetz, Buchta and Ho use a combined optical lever and electrical method in order to obtain the desired amplification, and Prytherch uses an electrical method alone.

By a suitable choice of one or another of the dilatometers referred to, dilatometric studies of solids may be made between —200 deg. C.[5,1] and 1,500 deg. C.[13], and length changes varying from a fraction of a wave length of light[2] up to 0.1 or 0.2 in.[8] may readily be measured and recorded, though no one instrument will in general cover the entire range.

As stated above, among the many important metallurgical problems that may be attacked by the dilatometric method is that of the precise determination of temperatures of transformations in metals and alloys, either under equilibrium conditions or at known rates of heating and cooling. Obviously the dilatometer to be used in such determinations should be designed to give (1) a record of specimen volume changes, but not necessarily a record of absolute measurements, (2) constant and carefully controlled rates of heating and cooling, (3) an accurate record of specimen temperatures, (4) no change of specimen composition during heating and cooling, and (5) a low temperature gradient in the specimen. Since none of the dilatometers used previously satisfactorily meets all these requirements, the dilatometer about to be described was designed. The numerous data presented in a paper by Wells, Ackley and Mehl[18] show that this dilatometer gives excellent results both with respect to accuracy and reproducibility.

Design and Operation

In Figs. 1, 2, and 3 are indicated the general features of the design included in the development of the present dilatometer, Fig. 1 showing two dilatometers, back to back, mounted on one table. Briefly this instrument is a precision recording differential dilatometer which records differential dilatation-temperature curves on photographic paper wound on a drum [(8) in Fig. 2]; the temperature coordinate is provided by driving the drum from a suppressed zero Micromax recording controller, [(10) in Figs. 1, 2—method similar to that used by Eddy[19]], while the dilatation coordinate is obtained by optical lever amplification of the difference of expansion between a specimen and comparison pieces. The amplification is 500. Using 1-in. specimens the differential-dilatation scale is 0.002 in. per in. and the temperature scale 30 deg. C. per in.

Controlled heating and cooling rates of 2, ½, and ⅛ deg. C. per min. are obtained by the use of a Micromax indicating controller [(14) in Figs. 1, 2], the temperature of control of which is changed at a uniform rate by Telechron chart movements [(15) in Figs. 1, 2]. Oxidation and decarburization (in steels)

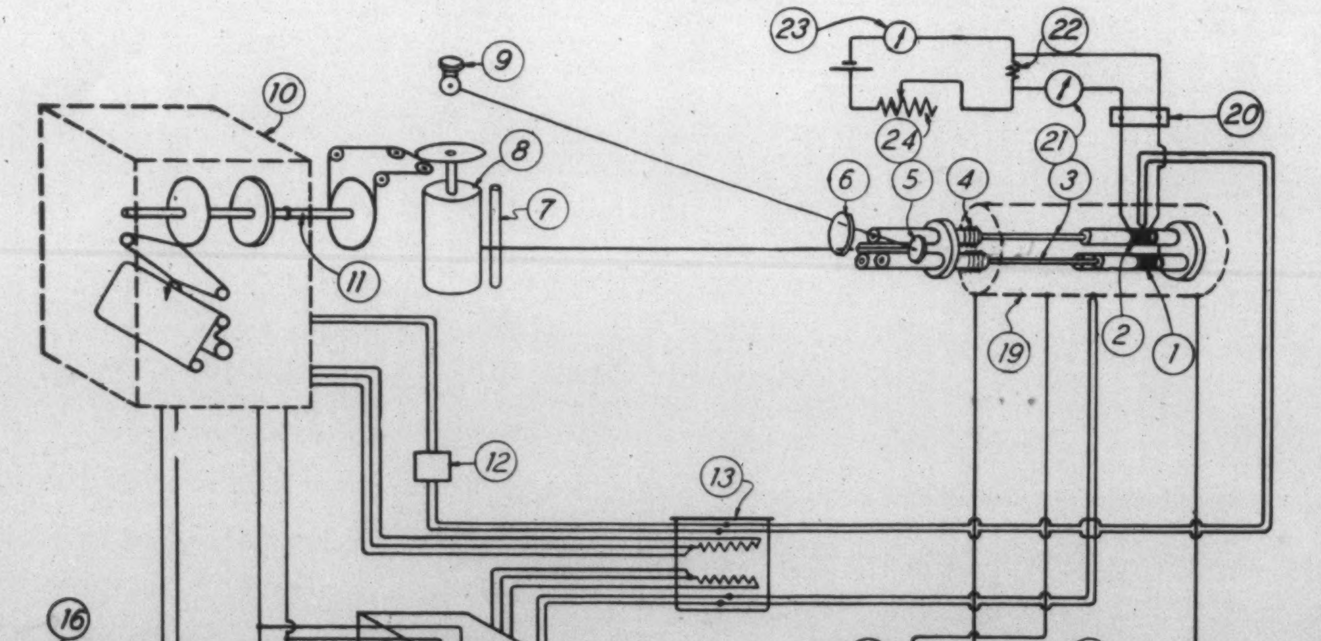


Fig. 2.—Arrangement of the Parts of the Dilatometer; (1) comparison pieces, (2) specimen, (3) silica push rods, (4) springs, (5) stainless steel mirror, (6) spherical lens, (7) cylindrical lens, (8) camera drum, (9) light source, (10) Micromax recorder, (11) drive shaft extension, (12) switching arrangement to Leeds & Northrup Type K2 potentiometer (not shown), (13) cold junction and compensating coil stabilizer, (14) Micromax controller (15) Telechron chart movement, (16) thermally insulated box containing dry cells, (17) mercury power relay, (18) rheostats, (19) furnace, (20) differential couple cold junctions, (21-22-23-24) direct reading potentiometer pyrometer.

are prevented by the use of a vacuum maintained at less than ½ a micron of mercury pressure. (An inert gas may be used instead of a vacuum if metals and alloys having comparatively high vapor pressures are to be investigated.)

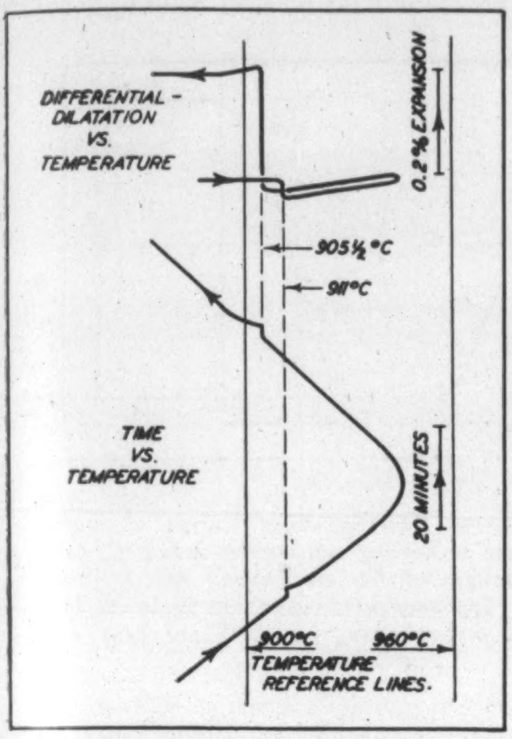


Fig. 4.—Typical Differential Dilatation-Temperature and Temperature - Time Curves of A_3 Transformation in High Purity Iron at 2 deg. C. per min. Heating and Cooling Rate, with Comparison Pieces of 4 per cent Silicon, Iron - Silicon Alloy. (Reduced from original size, i.e., "20 min." = 1 in., etc.)

For accurate results the specimen must have a uniform temperature throughout, because the dilatation of the whole of the specimen between shoulders [(1, 2) in Fig. 3] is plotted against the temperature of one spot only {the location of the thermocouple [(25) in Fig. 3] which actuates the temperature recording mechanism.} Most previous dilatometers have been very remiss in this feature. This is accomplished by use of a resistance furnace in which currents in independent front and rear windings are easily controlled. A differential thermocouple with one junction at each end of the specimen serves to measure the temperature gradient in the specimen and to indicate what current adjustments should be made to maintain the gradient below ½ deg. C. or so. The differential couple is formed by spot welding a constantan wire [(26) in Fig. 3] to each end of the specimen. Specimen temperature gradients are indicated by the direct reading potentiometer system [(21), (22), (23), and (24) in Fig. 2] and these are controlled by use of the adjusting rheostats (18), one of which is in series with the front winding of the tubular resistance furnace (19) and the other in series with the rear winding. Time-temperature curves are recorded by the Micromax recorder controller [(10) in Figs. 1, 2], temperature as abscissa, 30 deg. C. per in., and elapsed time as ordinate, 20 min. per in. Both the differential dilatation-temperature and time-temperature curves are recorded simultaneously.

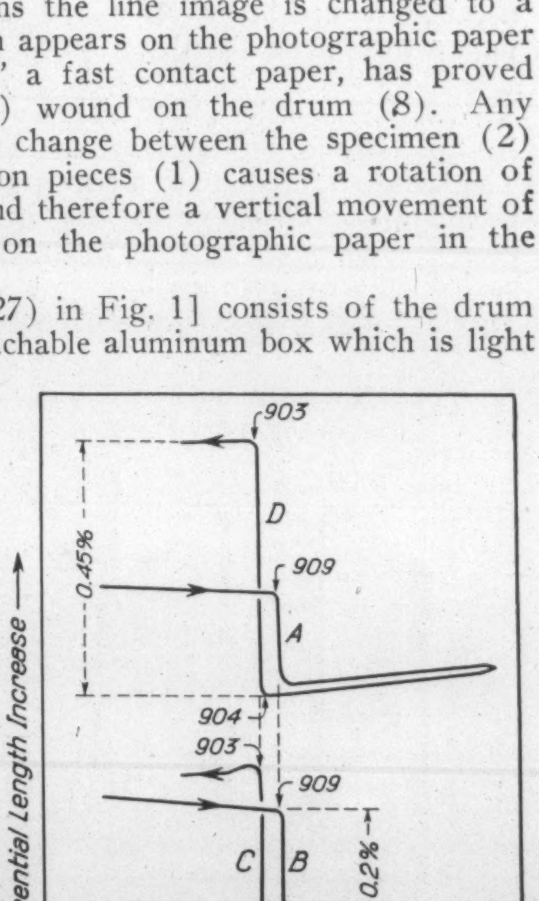
After disconnecting the drum [(8) in Fig. 2] from the Micromax temperature controller (10) and connecting a Telechron chart movement to the drum by means of flexible cord and pulleys of suitable sizes, differential-dilatation vs. time curves may be recorded. The time scale may be very open; scales of approximately 1, 2 and 20 mins. per in. respectively have been used. The differential-dilatation scale is 0.002 in. per in., using 1-in. specimens. The relationship of the dilatometer parts to the instrument as a whole should be evident from the sketch in Fig. 2 and the description which follows.

Length changes which occur in the specimen (2) and the two comparison pieces [(1) in Figs. 2, 3] (When the dilatometric properties of iron and plain carbon steels were investigated comparison pieces made of a 4 per cent silicon iron-silicon alloy were used. This alloy consists of a solid solution which has the same coefficient of expansion as the α phase in iron and iron-carbon alloys, but shows no allotropic changes between room temperature and 950 deg. C.) are transmitted along composite metal and silica "push rods" [Strictly speaking these are not rods, but each consists of metal rods, metal tubes and a silica rod connected together (Fig. 3). They are referred to as "push rods" to facilitate the description of the dilatometer.] to the stainless steel mirror (5) which forms part of the optical system (9, 6, 5, 7, and 8 in Fig. 2). The push rods pass through a rigid framework of Monel metal tubes and radiation screens. Specimen and comparison pieces are press-fitted into Monel metal tubes (Fig. 3—lower right) to assure good contacts, and push rod metal-silica contacts are maintained by pressure from springs (4). Rollers shown in Fig. 3 support the push rods and facilitate the transference of length changes from the specimen and comparison pieces, respectively, to the optical system.

The optical system consists of the stainless steel mirror [(5) in Figs. 2, 3] mounted on the end of a double knife edge. The lower edge rests on the two comparison piece push rods and the upper edge bears against the specimen push rod. The source of light is the single filament galvanometer lamp (9) whose line image is formed on the glass stirring rod cylindrical lens (7) by the spherical lens (6). By using the cylindrical lens the line image is changed to a point image which appears on the photographic paper ("Solar bromide," a fast contact paper, has proved quite satisfactory) wound on the drum (8). Any differential length change between the specimen (2) and the comparison pieces (1) causes a rotation of the mirror (5) and therefore a vertical movement of the point image on the photographic paper in the camera.

The camera [(27) in Fig. 1] consists of the drum enclosed in a detachable aluminum box which is light tight except for the narrow slit made in one side to admit the point image referred to above. The box [(28) in Fig. 1] extending from the mirror to the camera protects the latter from receiving too much extraneous light. The alignment of the camera and other parts of the dilatometer is facilitated by the use of a piece of channel iron as is indicated in (29) Fig. 1. The camera drum [(8) in Fig. 2] and the Micromax recorder controlled shaft (11) are so con-

Fig. 5. — Differential Dilatation - Temperature Curves of A_3 Transformation in High Purity Iron Showing Reproducibility with Respect to Temperature of Transformation. Heating and cooling rate—2 deg. C. per min. (Reduced from original size, i.e., 0.2 per cent = 1 in., etc.)



nected by cord and pulleys that a movement of the recorder pen causes a drum periphery movement of the same magnitude. This makes it possible to use an identical temperature scale (30 deg. C. per in.) for the simultaneous recording of specimen temperatures on the Micromax recorder chart and on the photographic paper respectively. (This open scale is secured by using a recorder having a suppressed zero and designed to record temperatures between 600 and 900 deg. C. on a 10-in. temperature scale. By adding or subtracting a known E. M. F. to the couple E. M. F. the recorder range of 600 to 900 deg. C. may be raised or lowered as desired.)

A chromel-alumel thermocouple [(25) in Fig. 3] with the hot junction embedded in the specimen and suitably connected to the Micromax recorder controller is used in the measurement of specimen temperatures. For convenience the couple lead wires pass from the specimen to binding posts located in the vacuum chamber; from these posts other suitable lead wires pass through a vacuum seal to the couple cold junctions, which in turn are connected by copper wires to the recorder. The thermocouples are made from No. 28 gage chromel and alumel wire calibrated by standard methods. A detailed description of the precautions that have been taken to ensure an accurate recording of temperatures may be found elsewhere.[18]

From the description already given it is apparent that a combined specimen temperature change and differential length change between the specimen and comparison pieces result in a differential dilatation-temperature curve being registered on the photographic paper wound on the drum [(8) in Fig. 2]. Simultaneously a time-temperature curve is drawn on the Micromax recorder chart, as usual. This chart [shown by (10) in Fig. 1] moves at the rate of 20 mins. per in. The differential dilatation-temperature and time-temperature curves shown in Fig. 4 are typical of those recorded when an iron specimen and iron-silicon comparison pieces were used.

While the recorder is being operated, the thermocouple E. M. F. is replaced by a known E. M. F. and reference marks are drawn on the Micromax recorder charts and reference lines are flashed across the photographic paper on the drum (8) to represent temperatures known to be correct to within ± 1 deg. C. This procedure makes it possible to apply any necessary corrections to the temperature data provided by the dilatometric and thermal curves, and thereby eliminates two possibilities of error, one caused by the shrinkage of the photographic paper when developed and dried and the other by slight changes occurring in the recorder over long time periods.

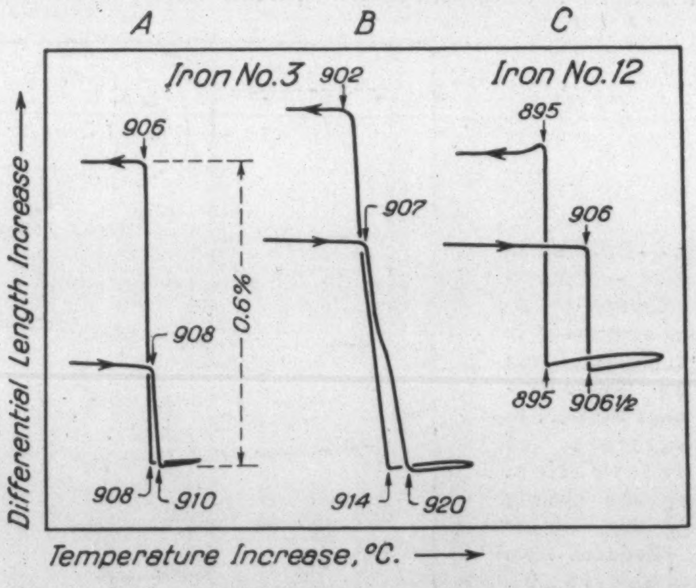


Fig. 6.—Differential Dilatation Temperature Curves Showing Influence of Temperature Gradient in Specimen on Temperature Spread of A_3 Transformation in High Purity Iron. Rates of heating and cooling ½ deg. C. per min. (curve C). Temperature gradient in specimen lengthwise ½ deg. C. in A and C and 10 deg. in B. (Reduced from original size, i.e., 0.6 per cent = 3 in., etc.)

To control the rates of heating and cooling a Micromax indicating controller [14) in Figs. 1 and 2] is used in which a "Telechron chart movement" [(15) in Figs. 1 and 2] connected to the controller by a friction drive replaces the usual hand control. By using "chart movements" of three different gear ratios three different rates, ⅛, ½, and 2 deg. C. per min. have been obtained. To secure as constant a rate of temperature change as possible, the hot junction of the thermocouple connected to the controller is placed quite close to the furnace winding. In order to maintain a uniform slow rate of ⅛ deg. C. per min., it has been found necessary to move the dry cells from the recorder cases to a thermally insulated box [(16) in Fig. 2] and the compensating coils and cold junctions to a stabilizing water bottle (13).

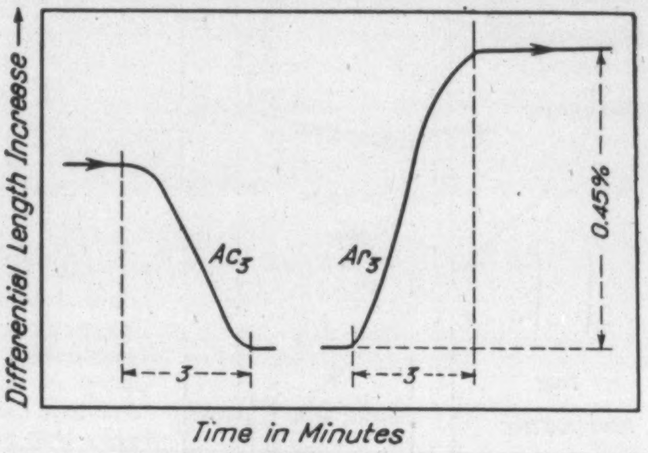


Fig. 7.—Differential Dilatation-Time Curves of High Purity Iron. Rate of heating and cooling 2 deg. C. per min. Curves designated Ac_3 are heating and Ar_3 are cooling curves. Specimen used was 1 by ⅜ by ⅛ in. (Reduced from original size; i.e., 0.45 per cent = 2¼ in., etc.)

By means of a switching arrangement [(12) in Fig. 2] the Leeds and Northup type K2 potentiometer may be connected either in series with the couple circuit for changing the temperature range of the recorder or directly to the recorder for calibration purposes.

The vacuum is maintained at half a micron of mercury or less by a simple mercury diffusion pump backed by a "Hyvac" pump. The higher limit of this pressure is determined by the absence of a discharge in an 8-in., 30,000 volt discharge tube.

Results

THE dilatometer described above has already been used for the determination of transformation temperatures in high purity iron and high purity iron-carbon alloys and many dilatometric and thermal data have been accumulated. These show that the dilatometer, properly used, records results which are accurate and reproducible to within ± 1 deg. C. The numerous data obtained in a dilatometric investigation of the α-γ transformation in iron have already been published[18]. In order to obtain the best results the precautions previously mentioned must be taken. Instruments and thermocouples must be carefully calibrated from time to time, and specimen temperature gradients must be kept low (¼ deg. C. or less is satisfactory) if results as good as those indicated in Fig. 5 are to be obtained. (Tracings rather than the original reproductions of curves are shown in Fig. 5, 6, 7 and 8 because the original curves are not of sufficient contrast to be satisfactorily reproduced.)

This figure (Fig. 5) shows the curves recorded in two consecutive dilatometric analyses of a specimen of high purity iron, curves B and C being recorded in the first and A and D in the last analysis.

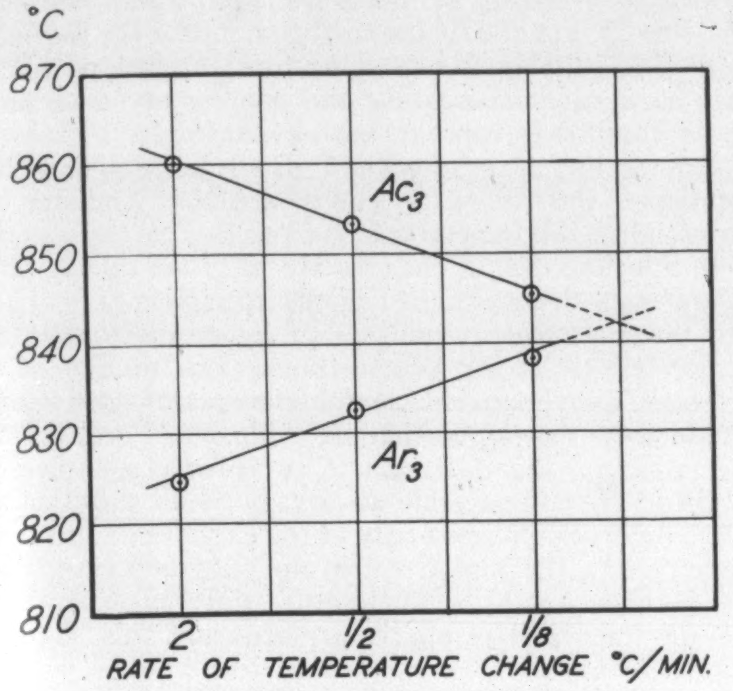


Fig. 8.—The Extrapolation of Ac_3 and Ar_3 Data to Equilibrium Temperature for a 0.16 per cent carbon, Iron-Carbon Alloy.

In both analyses the heating and cooling rates were 2 deg. C. per min. The length changes were not reproducible in the consecutive tests for reasons already discussed[18]. To show the effect of specimen gradient on the results obtained, two tests were made using a specimen of high purity iron, one in which the temperature gradient in the specimen lengthwise was ½ deg. C. or less and the other in which the gradient was 10 deg. C. The results are shown in Fig. 6 (curves A and B) and serve to emphasize how essential it is to maintain a low temperature gradient in the specimen during test if accurate results are to be obtained. An examination of curve A Fig. 6 shows a 2 deg. C. difference between the beginning and end of the transformations under the best conditions normally used. This may have been caused by a (2 deg. C.) transverse gradient in the specimen originating in the unsymmetrical placement of the specimen with respect to the hot walls of the vacuum chamber, for the upper edge of the flat specimen is directly exposed to the heat while the lower edge is not.

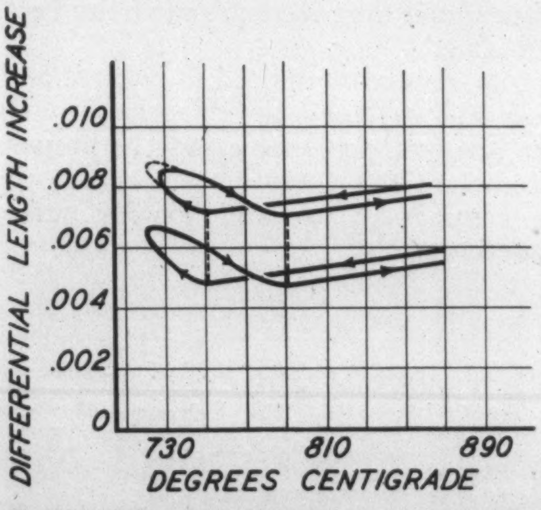


Fig. 9.—Differential Dilatation vs. Temperature Curves for A_3 Transformation of an iron = (0.43%) Carbon Alloy Showing that No Change of Composition Occurred during the Dilatometric Analysis. Rate of heating and cooling was 2 deg. C. per min. The specimen was held at 870 deg. C. for 10 hrs. between the test producing the upper curve and that producing the lower curve. (Reduced from original size; i.e., 60 deg. C. = 2 in., etc.)

The use of radiation screens would probably be useful in this instance. Thermal arrests in iron could only be observed with certainty when the specimen was heated or cooled at rates faster than ½ deg. C. per min. Typical differential-dilatation time curves are shown in Fig. 7. The rate of heating and cooling was 2 deg. C. per min. and the specimen was high purity iron. Fig. 8 shows the methods of extrapolating to equilibrium rate from data at three different rates, (in this case 2, ½, and ⅛ deg. C. per min.). The plot is seen to be semi-logarithmic which results in almost straight line curves.

That the vacuum (½ micron of Hg or so) maintained in the hot zone of the dilatometer during operation is sufficient to prevent steels from decarburization (and presumably many metals and alloys from oxidation) is indicated by the results shown in Fig. 9. Between the recording of curves A and B and C and D, respectively, the specimen was heated in the dilatometer at 870 deg. C. for approximately 10 hrs. The Ac_3 and Ar_3 temperatures in the iron-carbon specimen were changed less than 1 deg. C. by the heat treatment (compare curve A with C and B with D in Fig. 9. This indicates that the amount of decarburization was not more than 0.005 per cent C, since the loss of an amount of carbon greater than this would have decreased the Ac_3 and Ar_3 temperatures by more than 1 deg. C. That the vacuum maintained in the dilatometer during tests is sufficiently high to prevent decarburization is further confirmed by the fact that an iron-carbon alloy dilatometric specimen of eutectoid composition showed no structural change at the very edge after being heated in the dilatometer for 3-½ hrs. at 875 deg. C. (Fig. 10).

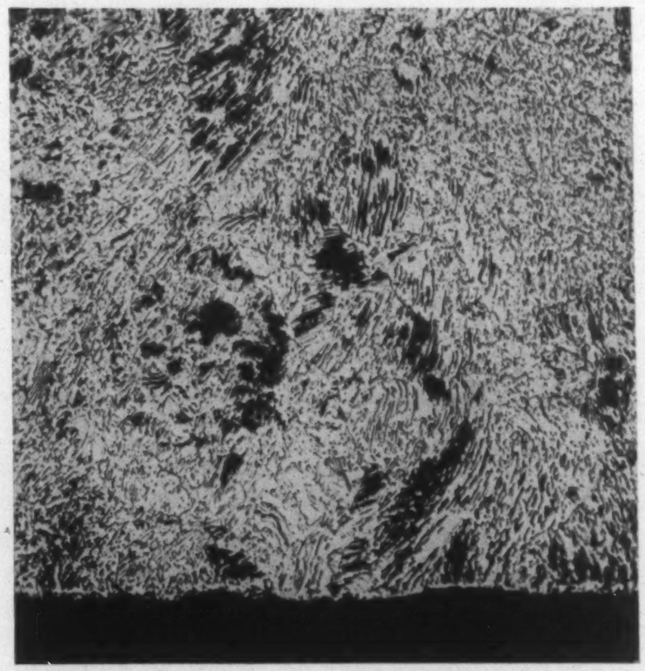


Fig. 10.—Transverse Section Micrograph at 250 Diameters Etched with Nital of a High Purity Iron-Carbon Alloy (0.77% C.) Showing No Decarburization at very Edge (bottom of photomicrograph) after Holding at 875 dec. C. for 3½ hrs. and cooling at 2 deg. per min.

Discussion

Of the advantages, which are exclusively characteristic of the dilatometer described, the following are important: Heating and cooling are controlled to give desired and constant rates; specimen temperature gradients are measured and controlled; the zero of the temperature scale is suppressed enabling a very open scale to be used; spurious dilatations due to the changing of the specimen contact surfaces are eliminated by use of the "press fit" between the specimen and Monel metal tubes; and time-temperature and differential dilatation-temperature curves are recorded directly and simultaneously; the dilatometer is sufficiently rigid to prevent ordinary vibrations from causing spurious length changes to be recorded in the dilatometric curves.

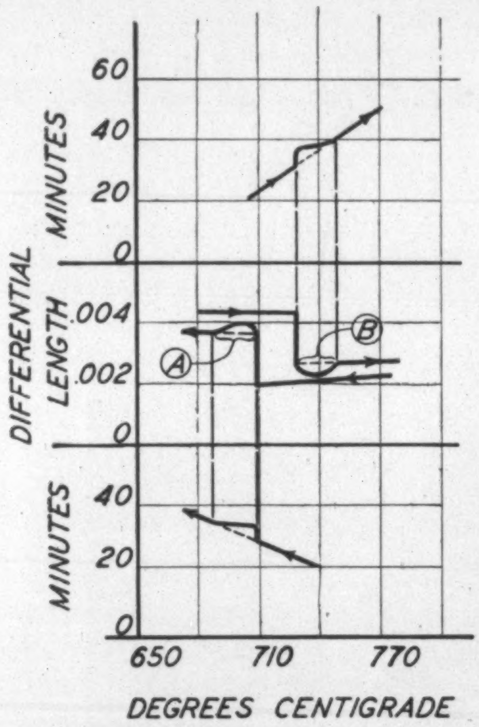


Fig. 11.—Differential Dilatation-Temperature and Time-Temperature Curves for A. Transformation in an eutectoid, iron-carbon alloy showing the effect of the thermal arrest in the specimen when not accompanied by a similar arrest in the comparison pieces. [Curves should be as shown dotted at (A) and (B), see text.] (Reduced from original size, i. e., 30 deg. C. = 1 in., etc.)

Among the advantages common to the above and to other dilatometers are the following: Temperatures of the specimen are recorded directly; this fact is emphasized because many dilatometers have been designed which record temperatures of a comparison piece or of some other part of the dilatometer instead of specimen temperatures with the result that many erroneous dilatometric curves have been published. A further advantage is that the specimen, unlike that used in many dilatometers (in interferometer dilatometers for example) is large enough to be used for chemical analysis after the dilatometric and thermal analyses are complete.

One very important advantage of all dilatometers is that their usefulness does not depend on the rate of heating or cooling of the specimen. Therefore the dilatometric method of investigation unlike the thermal method is suitable for studying transformations when very slow rates of heating and cooling are used and under conditions approaching equilibrium.

Among the most important disadvantages may be mentioned the following (these are also common to many other dilatometers):

1. Spurious length changes are recorded during and following a thermal arrest in the specimen (Fig. 11). (In the dilatometric analyses of hypo-eutectoid iron-carbon alloys having compositions close to that of a eutectoid alloy, spurious length changes of such magnitude were developed that all evidence of Ac_3 transformation on the dilatometric curves was completely masked.) The open scale advantage of all differential dilatometers is obtained only at the expense of this disadvantage; a thermal arrest in the specimen results in the development of a temperature difference between the specimen and comparison pieces and this in turn causes an undesirable differential length to be established between the specimen and comparison pieces. This effect is shown in Fig. 11 by the portions of the curves marked A and B which would be dotted as shown if the comparison piece had remained at the temperature of the specimen.

2. Visual observations cannot be made of the curves as they are being recorded.

3. Large metal parts, hot at one end and cold at the other, contribute to the difficulty of eliminating spurious length changes developed by temperature gradients; this is especially true when the rates of heating and cooling are changed. By the method previously described the authors have succeeded in maintaining specimen temperature gradients below ¼ deg. C. during tests, but much time is required if the best results are to be obtained.

4. About 2½ hrs. are required to prepare and mount the specimen and assemble the dilatometer. This time is probably longer than is necessary to prepare many other dilatometers for operation, especially those designed for commercial use and not for making precision measurements.

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Resistance to Damage by Overstress

of

Precipitation-Hardened Copper-Steel and Copper-Malleable

By H. W. RUSSELL

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THE ABILITY OF A STEEL to "take it" under repeated load is not wholly reflected by the endurance limit determined on nicely polished and well-filleted specimens. The way it acts with a severe notch, such as the 90-deg. square notch, used by Kommers[1] gives another clue to its behavior in service. A still further clue is gained from finding out, on both regular and square-notched specimens, what loads above the endurance limit it will stand and for how many cycles, without being damaged, damage being determined by re-running the over-stressed specimen at the endurance limit and noting whether it breaks prematurely—a sign of damage—or whether it runs on to 10 million cycles, thus showing no sign of damage. By running several specimens at various degrees of overstress and for varying numbers of cycles it is possible to determine a stress-cycle curve, called the "damage line" above which damage occurs, but below which damage has not resulted in spite of overloading. At the high-cycle end of the curve it merges into the regular S-N endurance curve.

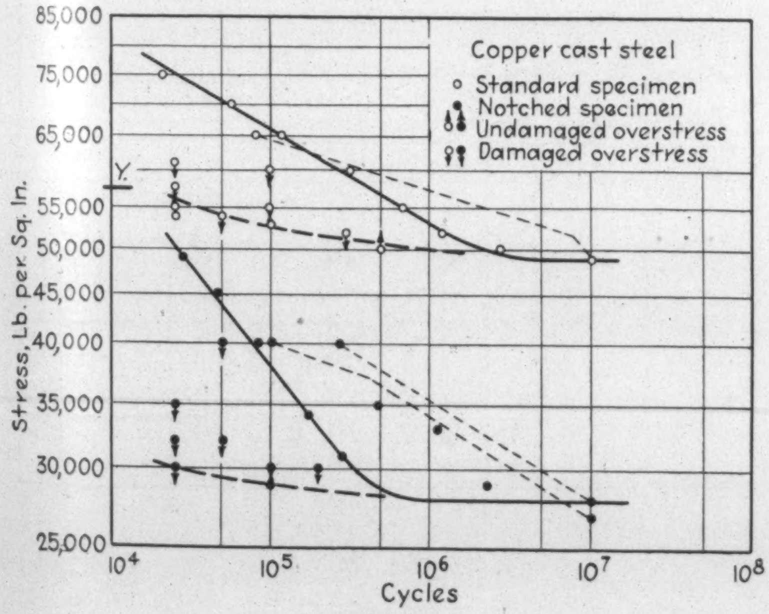

Fig. 1a.

This method of evaluating ability to come through a period of overload, either injured or unscathed, was described by French[2] and discussed in more detail in an earlier paper from this laboratory[3], as well as by Moore[4] and by Brophy[7].

Variations in Results

It was shown in these papers that different irons and steels and different heat treatments gave entirely different results, ranging from those, like a sample of ingot iron and one of carbon steel, that were appreciably damaged by only a few cycles at almost any load above the endurance limit, to those, like 18 and 8 and some lots of wrought iron, that would stand hundreds of thousands of cycles of really high overload without harm. Sometimes this ability to stand overload, or the lack of it, was more marked in the un-notched and sometimes in the notched specimen, but in general, both types of specimens of a given alloy with a given treatment tended either to be good or to be bad.

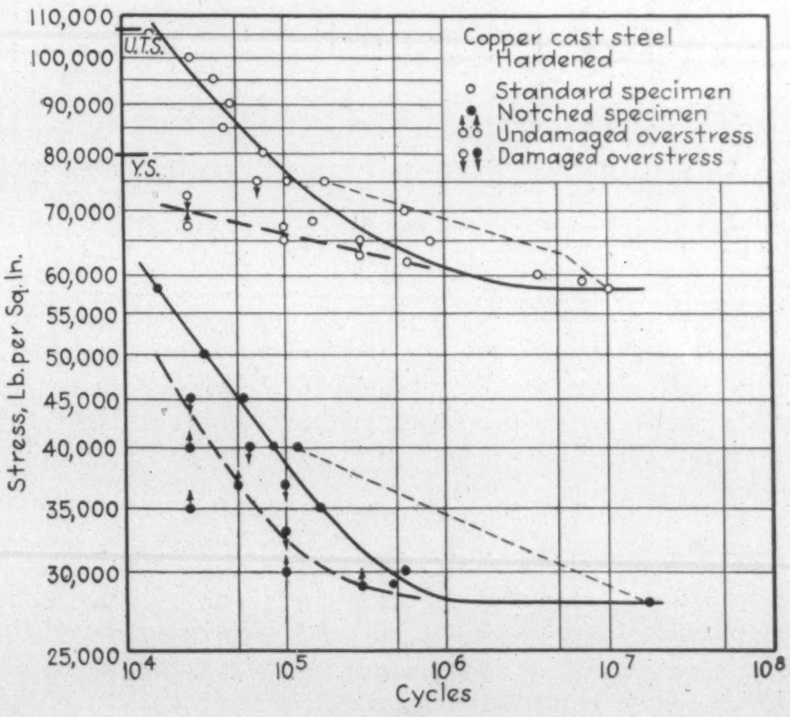

Fig. 1b.

This method of testing is tedious and too few results are available to allow one to generalize as to the underlying causes of damage-resistance and susceptibility to damage. Any observations that, subsequently buttressed by others, may ultimately lead to knowledge by which the highly desirable property of damage-resistance can be built into alloys, seem important.

In the course of the prior work a peculiarity of two lots of material was noted. A copper steel containing 1.2 percent Cu, carrying the copper in solution (i. e. without precipitation-hardening treatment) showed rather poor resistance to over-stress, as shown by the dashed lines in Fig. 1a, but after precipitation-hardening it showed very good resistance to over-stress, especially on the notched specimens, (Fig. 1b). (The notched endurance curves are plotted on the calculated stress at the base of the notch, without correction for stress concentration). The static strength had been materially improved and the ordinary endurance limit rose accordingly. In terms of overload, at 65,000 lbs. per sq. in., the non-precipitation hardened material, in the standard specimen, would break in a little over 100,000 cycles and would not stand 100,000 cycles at 55,000 lbs. per sq. in. without damage, while the precipitation-hardened one would stand 100,000 cycles at 65,000 lbs. per sq. in. without damage. The notched non-precipitation-hardened material would not stand 25,000 cycles at 30,000 lbs. per sq. in. without damage, while after precipitation-hardening it would stand 50,000 cycles at 37,000 lbs. per sq. in. without damage.

Similarly, a 1.12 percent Cu copper malleable containing 1.12 percent Cu, in the non-precipitation-hardened state appeared, as Fig. 2a shows, to have no resistance at all to overload, the "damage" lines being horizontal at the endurance limits. Precipitation-hardening pulled the tensile strength up about 8000 lbs. per sq. in. and though it raised the regular and the notched endurance limits only 1000 lbs. per sq. in., it did wonders for the damage lines, especially for the notched specimens, as is shown in Fig. 2b.

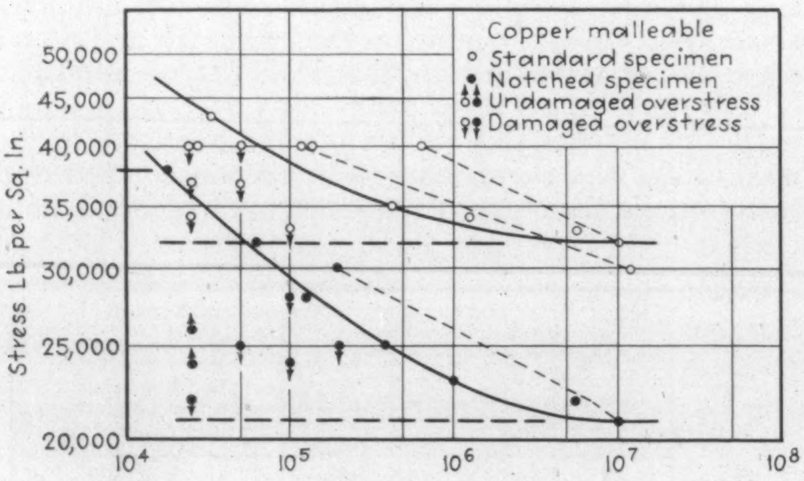

Fig. 2a.

The Ford Crankshaft Studied

The Ford crank-shaft alloy, sometimes called "steel" but here termed "cast pearlitic malleable" since it is cast white and then malleablized, likewise showed, in the as-received condition, cut from a production V8 shaft, only slight ability to stand loading above the endurance limit on the standard specimen and none on the notched specimen (See Fig. 3a). The notched endurance limit, 31,000 lbs. per sq. in., is higher than that for some other materials of higher static strength, so that the good service performance of the material is probably ascribable to the high endurance limit.

This Ford crankshaft alloy, containing 1.78 percent Cu and 1.66 percent C, is not markedly improved in static strength by precipitation-hardening since it is well known, and thoroughly discussed by Gregg and Daniloff[5] that the high carbon steels and irons carrying suitable copper contents for precipitation-hardening effects do not respond to the precipitation-hardening treatment to any marked degree. For example, a low carbon steel with 1 percent Cu will have its yield and tensile strengths increased some 20,000 lbs. per sq. in. (as was the case with the copper cast steel of Figs. 1a and 1b), while a rail steel of 0.85 percent C and 1 percent Cu will only be increased in strength some 10,000 lbs. per sq. in., and in a cast iron of 3.10 percent C, 1.8 percent Cu, the precipitation-hardening treatment had no effect on the strength. But while the strength of the crankshaft alloy is not affected, there will nevertheless be a separation of discrete, though sub-microscopic, particles. These might be expected to exert a "cushioning" effect within the alloy and possibly to mitigate the effect of localized stress—i. e. to help provide damage-resistance against repeated overstress. This possibility was mentioned in the previous publication.

Effect of Precipitation Hardening on Crankshaft

Putting this prediction to the test, it was found that by applying the regular precipitation-hardening heat treatment (see Table 2) to the specimens cut from the Ford crankshaft, the static strength was not altered (see Table 3), nor was the regular endurance limit on unnotched specimens changed, but their resistance to damage by overstress was markedly improved. The effect upon the notched endurance bars was even more spectacular. The notched endurance limit was raised from 31,000 to 34,000 lbs. per sq. in. and whereas, without the precipitation-hardening treatment, the notched bars showed damage in 25,000 cycles at 33,000 lbs. per sq. in., those that had the precipitation-hardening treatment stood 50,000 cycles at 45,000 lbs. per sq. in. and then ran 10 million cycles unbroken at 34,000 lbs. per sq. in. Thus all three of the precipitation-hardened copper cast steels and malleables were given marked resistance to repeated overstress, especially on notched bars. While the shape of the whole damage line is of interest, in order to express damage resistance by a single coefficient, for brevity rather than accuracy or completeness, the ratio of the stress at 25,000 cycles on the damage line to the endurance limit, is shown in the right hand columns of Table 4. A coefficient of 1 means no resistance to damage.

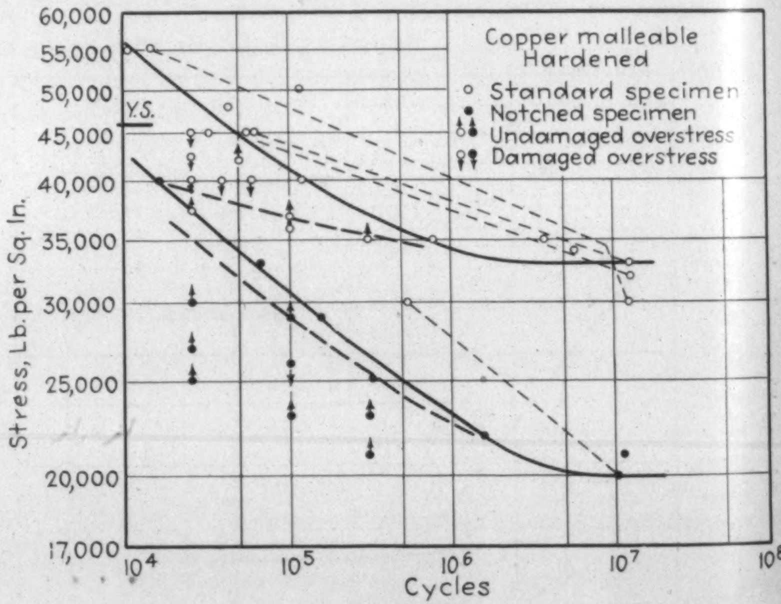

Fig. 2b.

Since such marked resistance to damage by overstress was developed by the precipitation-hardening treatment of the Ford crank shaft, without producing any static ductility (Table 2) it seems evident that static ductility is not an essential requirement for ability to withstand repeated overload. One might postulate that the separation of copper particles increased the damping ability which Föppl considers directly related to ability to stand overstress, and Brophy[7] more conservatively refers to as a "factor in fatigue," but one would expect that the temper carbon particles present in the fully malleablized material of Fig. 2a and in the regular Ford material of Fig. 3a would confer plenty of damping ability.

On the other hand a non-copper malleable, described in the previous publication[3] did have ability to stand overstress. That some of the wrought irons described in the previous publication[3] showed good resistance to overstress indicates that hard discontinuities, like slag particles in a soft matrix, may also give ability to distribute local overstress. But pearlite patches in a ferritic matrix, as in the very clean and uniform 0.35 percent C carbon steel previously described[3] conferred practically no resistance to overstress. The single-phase 18 and 8, (also previously described[3]) had marked resistance. The work-hardening ability of the austenitic material must of course enter into consideration in this case.

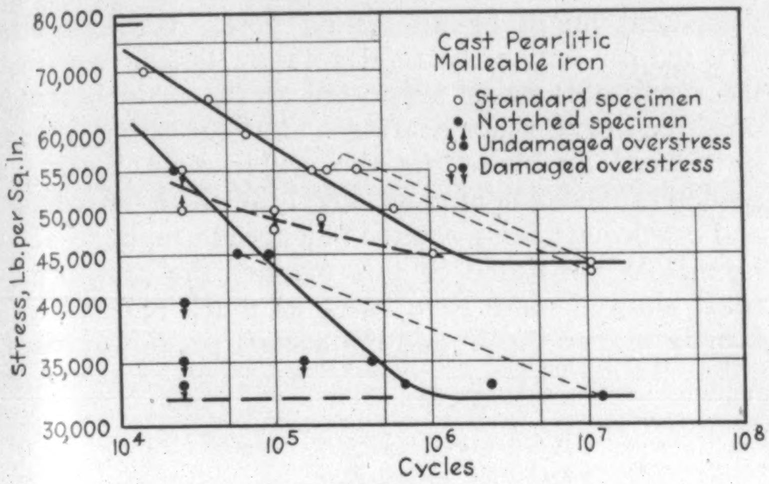

Fig. 3a.

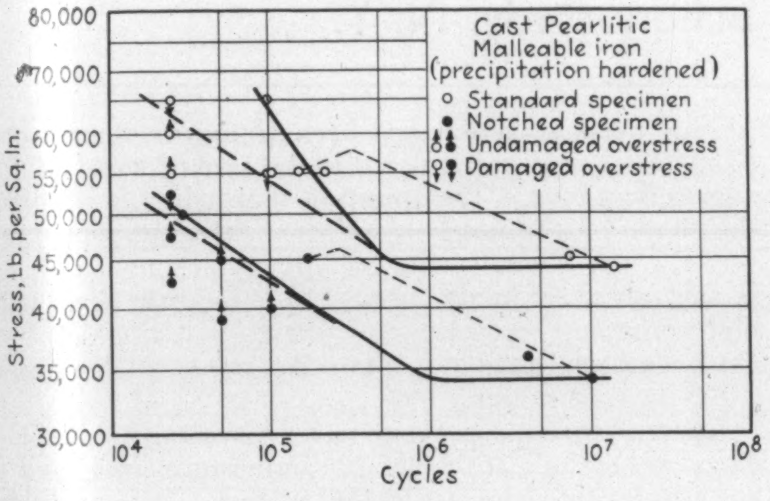

Fig. 3b.

Effect of Submicroscopic Particles of Copper

Thus no general conclusions can yet be drawn. It can be stated, however, that the separation of submicroscopic particles of copper by the precipitation-hardening treatment has consistently, in all three cases studied, conferred marked resistance to overstress.

These observations in turn lead to still another question, viz—would a copper cast iron, given the precipitation-hardening treatment, develop increased resistance to damage by repeated overstress, just as the Ford crank shaft did, even though the static properties are not markedly affected by the treatment?

TABLE 1.—Composition of Materials,—Per Cent

		C	Si	Mn	S	P	Cu	Cr
1	Copper cast steel.....	0.23	0.38	0.61	0.031	0.044	1.20	...
2	Copper malleable......	2.26	0.90	0.28	0.019	0.15	1.12	...
3	Ford cast crank shaft	1.66	0.89	0.70	0.030	<0.03	1.78	0.65

TABLE 2.—Heat Treatments—Temperatures In Deg. F.

	Regular		Precipitation-hardening
1a	—1 hr. at 1650°, air cooled		None
1b	do	plus	3 hrs., 930°
2a	—50 hrs., 1650°		None
2b	do	plus	1½ hrs. 1350° air cool; 3 hrs., 930°
3a	—Ford production treatment*		
3b	do	plus	1½ hrs. 1350° air cool; 3 hrs., 930°

* According to Cone[8] this is 20 min., 1650 deg., air cool to 1200 deg. reheat 1 hr. at 1480 deg., cool in furnace to 1000 deg. in 1 hr.

TABLE 3.—Static Properties

		Yield strength, lbs. per sq. in.	Tensile strength, lbs. per sq. in.	Elongation in 2 in., per cent	Reduction of area, per cent
1a	Cu steel	57500	88100	30.5	53.8
1b	Cu steel P-H...	79400	106300	24.	48.4
2a	Cu Mall.	38000	57250	19.	22.
2b	Cu Mall. P-H..	46100	65000	17.5	19.5
3a	Ford shaft	.....	78250	nil	nil
3b	Ford shaft P-H.	.....	79000	nil	nil

TABLE 4.—Endurance Properties

		Endurance Limit, lbs. per sq. in.		End. Ratio End.Lim. / Ten. Str.		Damage Ratio (Damage stress at 25000 cycles. divided by End. limit)	
		Standard polished spec.	Notched spec.	Std.	Notched	Std.	Notched
1a	Cu steel.......	49000	28000	0.56	0.32	1.14	1.07
1b	Cu steel P-H..	58000	28000	0.55	0.26	1.21	1.57
2a	Cu mall.	32000	21000	0.56	0.37	1.00	1.00
2b	Cu mall. P-H..	33000	22000	0.51	0.31	1.18	1.75
3a	Ford shaft	44000	31000	0.56	0.40	1.21	1.00
3b	Ford shaft P-H	44000	34000	0.56	0.43	1.43	1.74

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Comment by R. H. McCarroll, Ford Motor Co.

We were very much interested in reading the manuscript of this article. Dr. Russell is to be complimented both on the work done and its presentation. We would like to make some remarks which you can use as you see fit.

We also have realized the remarkably high resistance to fatigue of this crankshaft material which we have called "Copper-Silicon Steel." We note that this Ford crankshaft material in this article has been referred to as "Pearlitic Malleable." While this to some may seem to fit the material more properly, we have preferred to call this material "Copper-Silicon Steel" for the following reasons:

First: Referring to the iron-carbon diagram, this material is within the range previously defined as steel.

Second: The modulus of elasticity of this material is within the usual steel range, being from twenty-eight to thirty million and not within that of gray iron or that of malleable iron.

Third: Referring to the publication of a discussion at a meeting of the American Foundrymen's Association on "Pearlitic Malleable Irons" presented Jan. 27,

> 1936, at Cleveland, reference is made to high carbon cast steel as differentiated from pearlitic malleable because such steels as cast are solid, homogeneous single phased alloys. We believe that our crankshaft material fits these definitions of the A. F. A. for high carbon cast steel.
>
> *Fourth*: The Ford Motor Co. has a so-called "Quick Malleable" often given a heat treatment, leaving it purposely partially pearlitic, referred to in U. S. Patent No. 1,871,545 (McCarroll and Vennerholm).
>
> *Fifth*: This crankshaft material does not fit the definition given by Bornstein and Bolton in the A. S. M. Handbook, 1933 Edition, for any type of cast iron.

Because of the fine service record of this material in crankshafts, we hesitate to make any change, but believe there may be much in the question raised as to the possible improvement by precipitation hardening, and are carrying out trials along these lines, although this further expenditure of time on heat treating does not seem advisable for this part.

Apparently the physical properties in tension of this material given were taken from test pieces machined from large crankshaft sections. This often gives results not in line with the average. Average tensile properties we have obtained have been as follows:

E. L.	T. S.	Elong.	R. A.	B. H.
92,000	107,500	1.75%	2.25%	269

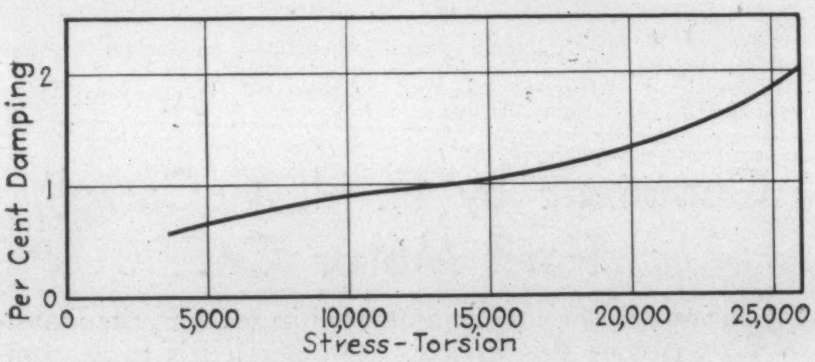
Please note that these are considerably higher than those given for the specimens tested.

As stated in the article, "The ability of a steel to take it under repeated load is not wholly reflected by the endurance limit determined on nicely polished and well-filleted specimens." Here, we would like to call attention to some actual service records over three years time during which the cast crank has proven more than twice as resistant to fatigue failure when compared with the forged crank previously used. Over 3,000,000 cast cranks are now in service.

A description of a practical method of fatigue testing on the whole crankshaft which we used in the development might be interesting here. We had constructed an extremely rigid rotating testing machine, the crankshaft being supported at the main bearings on three heavy roller bearings. Fatigue stresses were introduced by off-setting the center main bearing a predetermined amount, usually 1/32 in. from center, and crankshaft being rotated at a speed usually of 1200 r.p.m. When tested in this manner the cast crankshaft showed more than twice as much resistance to fatigue failure the forged crankshaft previously used.

Comment by G. R. Brophy, Metallurgist, Research Laboratory, General Electric Co., Schenectady, N. Y.

Dr. Russell's article on the effects of overstress is a good one, even though some of his results do not agree with ours. For instance, tests were conducted at the G. E. Research Laboratory on iron of approximately the same composition as that which he used and the endurance limit on smooth specimens was found to be 27,000 lbs. per sq. in. while the calculated notched endurance limit, using a "V" notch, was found to be 34,000 lbs. per sq. in.



Damping Capacity Curve of a Heat-Treated Cast Alloy.

This peculiar action has been found in other types of material, and particularly in the case of some of the austenitic alloys. The question that arises is whether the shape of the notch is a factor. In my paper, referred to by Russell, data are given, although nothing is said about it in the text, which indicate that with high damping capacity the sharp notch which we used was less damaging than the same notch with a 0.010-in. root radius.

Russell, in almost every case, has drawn his S-N diagrams to indicate a definite endurance limit, and I am wondering if he is justified in this. It is probable that lower values would result had he carried his tests out to more than 10^7 cycles, in which case somewhat higher damage lines would be located, although his conclusions probably would not be changed materially.

Herewith is a damping capacity curve of the heat treated cast alloy which shows relatively low values at the endurance limit and as a result we may expect high damage lines but also a high notch sensitivity. Both Russell's results and ours, on the contrary, show low notch sensitivity. This is very different from the general run of steels and I am inclined to agree with Russell that the precipitation of the soft copper accounts for this action.

Some Consequences of Graphitic Corrosion of Cast Iron

By W. A. WESLEY, H. R. COPSON and F. L. LAQUE

Messrs. Wesley and Copson are with the Research Laboratory and Mr. LaQue with the Research and Development Department of the International Nickel Co.

Abstract: Three ways in which formation of a graphitized layer upon cast iron can influence subsequent corrosion processes are discussed and illustrated by experiment or by examples from commercial practice. The graphitized coating may decrease or prevent further corrosion of the cast iron base, it may accelerate it, or it may accelerate the corrosion of uncoated iron in galvanic contact with the graphitized part. The latter effect may be of commercial interest when a graphitized piece of equipment such as a pump is equipped with a new part such as an impeller, or where a part of the equipment is kept free of graphite by erosion. In such cases the galvanic effect can be minimized by making the bare part of an alloy cast iron.

IT IS WELL KNOWN that cast iron exposed to certain types of corrosive environments suffers a peculiar form of disintegration called graphitization. In this type of corrosion much of the ferrite of the iron is removed from the affected zones leaving behind a black porous structure which may retain the form of the original metal but is devoid of its strength. The porous residual material is rich in graphite and carbides and usually contains a considerable amount of free iron. It is generally agreed that the contact between the ferrite and the graphite in the cast iron structure leads to electrochemical action between these constituents, the ferrite acting as anode and dissolving and the graphite acting as cathode.

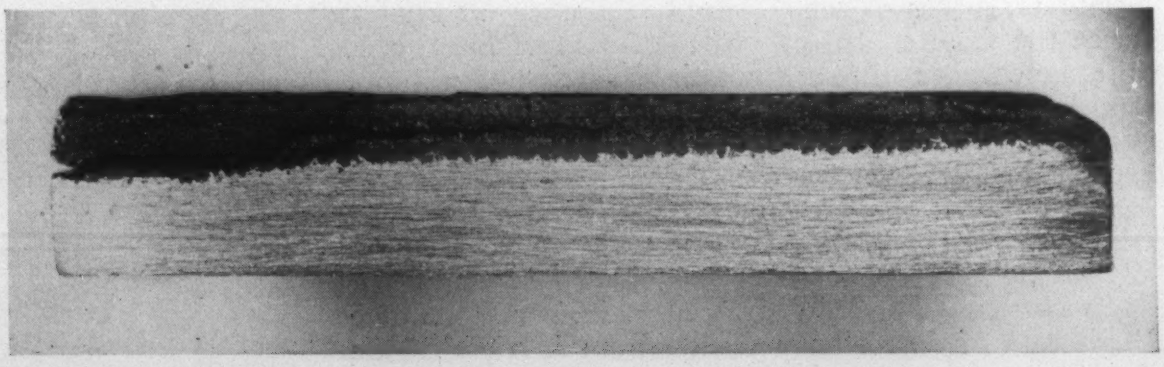


Fig. 1. Graphitic Corrosion of Cast Iron. Magnification 3 diameters

There are several possible consequences of graphitic corrosion which are not generally known or understood but which have been encountered in commercial installations:

1. The graphitized layer may decrease or prevent corrosion of the cast iron base. When the graphitic coating has reached considerable thickness, its pores may become thoroughly filled with solid corrosion products and other solid matter if the environment permit deposition of such materials. The clogged layer can decrease the rate of further corrosion of the base with the net result that the cast iron part may considerably outlast steel in similar service.
2. The graphitized coating may accelerate the corrosion of the cast iron base. The thickening of the layer tends to provide an increasingly large area of graphite surface due to the porous structure of the coating. In some environments the products of corrosion do not deposit in the pores. The galvanic effect of contact of the base with the large area of graphite may cause cast iron to corrode much more rapidly than steel in such a case.
3. When one part of a cast iron apparatus bears a graphitized coating and another iron part in galvanic contact with it remains uncoated, the rate of corrosion of the uncoated part may be greatly accelerated.

Observations in Practice

CAST iron occasionally displays corrosion resistance superior to other materials in commercial installations when the layer of graphite is sufficiently compact or plugged with insoluble corrosion products to be protective. Cast iron is used in preference to steel for the construction of stills for the manufacture of acetic acid from calcium acetate. It has been found to be more serviceable than steel for use in contact with paper stock containing chlorine in bleaching oper-

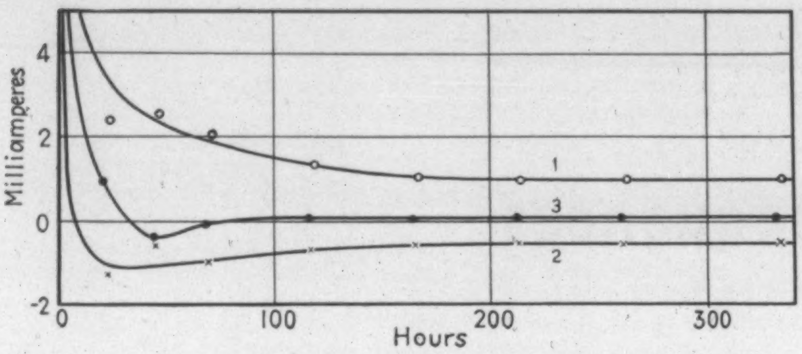


Fig. 2. Galvanic Currents flowing Between the Electrodes in the Following Three Cells:

Cell 1. Cast Iron/Aerated 3.5% NaCl/Cast Iron, Graphite Coated.
Cell 2. Ni-Resist/Aerated 3.5% NaCl/Cast Iron, Graphite Coated.
Cell 3. Ni-Resist/Aerated 3.5% NaCl/Ni-Resist, Graphite Coated.

Positive values indicate that the graphite-coated electrode was acting as cathode.

ations and for handling calcium hypochlorite from bleaching solutions.

Under conditions of operation of stills used to refine mixed stearic and oleic acids the surface of cast iron soon becomes graphitized. Some tests over a period of three weeks in an operating still showed the following rates of corrosion:

Material	Indicated Corrosion Rate in Inches Penetration Per Year
Mild steel	0.143
Unalloyed cast iron	0.79
Austenitic cast iron (Ni-Resist)	0.015

Contrary to the indications of these test data, practical experience over a period of years has often shown cast iron stills to be more serviceable than steel stills.

Examples of the second consequence of graphitic corrosion in which the rate of corrosion of cast iron is considerably greater than that of steel are more frequent. Recently some specimens of cast iron having an exposed area of about 0.5 sq. dm. each were immersed in a tank used to store a solution containing approximately 250 grams per liter of aluminum sulphate at about 35 deg. C. The duration of the exposure was 62 days. At the end of this time each of the cast iron specimens, 3/16 in. thick, and weighing about 80 grams, was almost entirely reduced to a residue of graphite, pieces of which could be broken off readily with the fingers. In spite of the extent of metal loss, the appearance of the graphitized specimens was not unlike that of a piece of solid iron; in fact, the original lathe tool marks on the edges of the turned specimens were well preserved.

Since the loss of metal was practically complete, the rate of corrosion of the cast iron was at least 2,500 mg. per sq. dm. per day, which is equivalent to penetration at a rate of about ½ in. per year. The high rate of corrosion was significant in view of the fact that specimens of mild steel exposed at the same time and under identical conditions were corroded at a rate of only 60 mg. per sq. dm. per day, or about one-fortieth the rate of the cast iron. This indicates that the corrosion of the cast iron was influenced by some effective accelerating agency, such as the galvanic effect between graphite and cast iron. This explanation was supported further by some potential measurements made using one of the specimens of cast iron after exposure, which then consisted principally of graphite, and an uncorroded specimen from the same heat of cast iron. The potentials of these specimens in a solution containing 250 grams per liter aluminum sulphate at 35 deg. C., referred to a saturated calomel half-cell were:

a. Corroded Cast Iron (Principally Graphite) .... —280 millivolts
b. Uncorroded Cast Iron .... —625 millivolts

Consequently, it was probable that the graphite layer formed during corrosion was as much as 345 millivolts more noble than the underlying and, as yet, uncorroded cast iron.

While the case just described refers to a corrosion test with relatively small specimens, similar graphitic corrosion occurs frequently on a large scale in practice. A few typical examples are pipe buried in certain soils, water jacketed cylinder liners in Diesel engines in marine service, casings and impellers in pumps handling corrosive waters and other solutions, presses used to handle spent mash in distilleries, and equipment used in contact with hot fatty acids.

The possibility that a graphitized surface may accelerate the corrosion of an iron part in galvanic contact with it will be discussed in greater detail.

Cathodic Behavior of Graphite

THE student of corrosion should not make the mistake of assuming that the chemical inertness of carbon means that it is electrochemically innocuous when placed in contact with metals in solutions of electrolytes. Graphitized carbon in a porous or finely divided condition, provided it is compact enough that the contact resistance between particles is not too great, is one of the most efficient cathode materials known. This is because it combines nobility of electrochemical potential with a large surface area per unit volume. Its behavior in commercial dry cells and other primary cells substantiates the above statements.

The potential of graphitized carbon as measured against a saturated calomel half-cell in aerated 3 per cent sodium chloride solution at room temperatures has been observed at various times in this laboratory to lie near that of polished platinum at from 0 to +200 millivolts. These readings were obtained after permitting the electrodes to remain on open-circuit for some time. Both electrodes showed great changes in potential when polarized by cathodically deposited hydrogen, the potentials becoming more negative (less noble). French and Kahlenberg[1] reported potentials

Fig. 3. Potentials of Various Electrodes in Aerated 3.5 Per Cent NaCl Against a Saturated Calomel Half Cell.

Cell 1. Cast Iron/Aerated 3.5% NaCl/Cast Iron, Graphite Coated.
Cell 2. Cast Iron, Graphite Coated/Aerated 3.5% NaCl/Ni-Resist.

In the galvanic couples the potentials were measured after the circuit was open 1 hr.

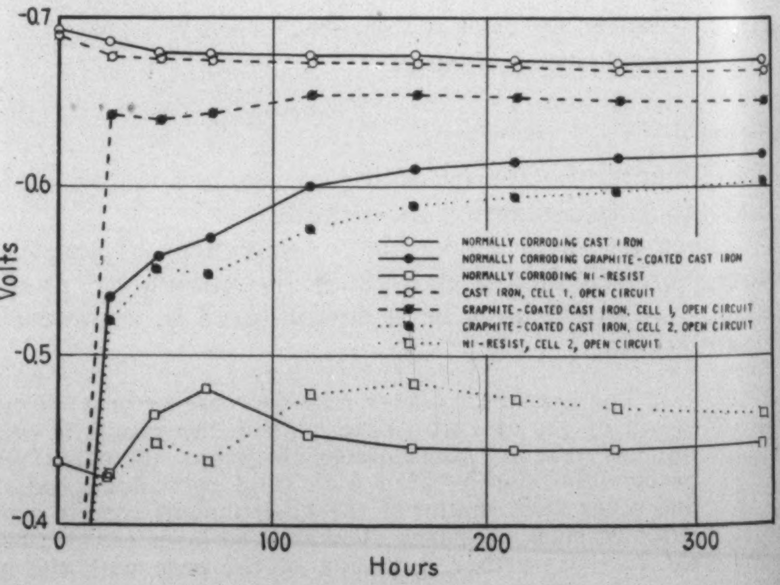


Table of Weight Loss Measurements and Calculations for Galvanic Corrosion Experiments

SOLUTION: 3.5% NaCl. RATE OF MOTION OF SPECIMENS: 4.7 Meters per min.
TEMPERATURE: 30 deg. ± 1 deg. C. VOLUME OF SOLUTION: 4 Liters
Potential and Current Measurements are Shown in Figs. 2 and 3
Cell 1. Cast Iron*/Aerated 3.5% NaCl/Cast Iron (Graphite Coated)
Cell 2. Cast Iron (Graphite Coated)*/Aerated 3.5% NaCl/Ni-Resist
Cell 3. Ni-Resist*/Aerated 3.5% NaCl/Ni-Resist (Graphite Coated)

			Approximate Area of Specimens Sq. Dm.	Time in Hours	Weight Losses Mg./Sq. Dm./Day		
					Run A	Run B	Average
Normal Corrosion Rates From Weight Loss Measurements		Cast Iron	0.28	339	202	252	227
		Cast Iron, Graphite Coated	0.27	339	46	20	33
		Ni-Resist	0.26	338	74	69	70
		Ni-Resist, Graphite Coated	0.21	337	46	34	40
Total Corrosion Rates of the Electrodes from Weight Loss Measurements	Cell 1.	Cast Iron (Anode)	0.28	339	342	393	368
		Cast Iron, Graphite Coated (Cathode)**	0.29	339	0	0	0
	Cell 2.	Cast Iron, Graphite Coated (Anode)	0.29	339	98	106	102
		Ni-Resist (Cathode)	0.28	339	12	34	23
	Cell 3.	Ni-Resist (Anode)	0.44	337	87	95	91
		Ni-Resist Graphite Coated (Cathode)	0.45	337	17	30	24
Average Galvanic Corrosion Rates of the Anodes	Cell 1.	From Weight Losses:	....	..	140	141	141
		From Ave. Galvanic Current (Run A 0.00189, Run B 0.00187 amp.)	....	331	177	175	176
	Cell 2.	From Weight Losses:	....	...	52	86	69
		From Ave. Galvanic Current (Run A 0.00074, Run B 0.00048 amp.)	....	331	65	45	55
	Cell 3.	From Weight Losses:	....	...	16	26	21
		From Ave. Galvanic Current (Run A 0.00035, Run B 0.00037 amp.)	....	329	20	23	22
			(Anodes)				
Final Steady Galvanic Corrosion Rates of Anodes (Average)	Cell 1.	From Final Steady Galvanic Current. (Run A 0.00095, Run B 0.00098 amp.)	0.278	...	88	91	90
	Cell 2.	From Final Steady Galvanic Current (Run A 0.00041, Run B 0.00068 amp.)	0.288	...	35	62	49
	Cell 3.	From Final Steady Galvanic Current (Run A 0.000095, Run B 0.000081 amp.)	0.435	...	5	5	5

* The galvanic currents were in such a direction that these electrodes were anodes.
** A slight increase in weight was recorded for these electrodes.

of graphite and platinum in aerated normal potassium chloride solution of 214 and 295 millivolts, respectively, while Bauer[2] observed the more noble potentials of 410 and 385 millivolts, respectively, in 1 per cent sodium chloride solution at 18 deg. C. These values all refer to the saturated calomel half-cell as standard.

Since the potential of iron corroding in a dilute sodium chloride solution at room temperatures is about –650 to –700 millivolts, it is evident that the open-circuit difference in potential between iron and graphite under these conditions is of the order of one volt. On closed circuit, as when in galvanic contact, the potential differences may be much reduced, chiefly owing to polarization of the cathode surface.

A recent example of severe galvanic corrosion between steel and carbon was quoted by Behrman and Gustafson[3]. Steel water-purification equipment filled with activated carbon was found to corrode rapidly. In laboratory tests Behrman and Gustafson found that considerable potential differences were set up between various metals and activated carbon when the couples were immersed in Chicago city water. As a means of avoiding the corrosion in commercial equipment it was decided to insert an insulating lining to prevent galvanic contact of the activated carbon with the container. It should be noted, however, that these workers found that only certain kinds of carbon used in water purification were destructive, namely, only the newer, highly activated forms.

Laboratory Tests

To illustrate the importance of the role which a graphite coating may play in the corrosion of underlying metal or of clean metal with which it is in contact some galvanic corrosion experiments were made under controlled conditions. Specimens of cast iron bearing a layer of graphitic corrosion product were coupled through external one ohm resistances to specimens of clean metal, and the currents flowing across the one ohm resistances were measured periodically while all the specimens were immersed in a salt solution. At intervals the circuits were left open for one hour and the potential of each electrode against a saturated calomel half cell measured. Included in the experiments were uncoupled specimens, and the potentials of these against a saturated calomel cell were measured also. The weight losses of all specimens were determined.

The experiments were carried out in the circular path apparatus described by Fraser, Ackerman and Sands.[4] The specimens, mounted in glass holders, moved at the rate of 16 ft. per min. in a vertical circular path. Adjacent specimens were about one centimeter apart. The electrolyte in all the experiments was 3.5 per cent sodium chloride solution. The solutions were kept saturated with air by passing a continuous stream through porous alundum crucibles immersed in the solution. The temperature was maintained constant at 30 ± 1 deg. C. A separate 4-liter jar was used for each experiment. Connections between the specimens and the external resistances were made with copper wires soldered to the specimens. The copper and solder were protected from corrosion by lacquer and paraffin.

Clean Cast Iron Coupled with Graphite-Coated Cast Iron

The graphite-coated electrodes were prepared by immersing cast iron specimens (containing 3.35% carbon and 1.67% silicon) in a hot 25 per cent aluminum sulphate solution for two weeks. At the end of this time the graphitization of the specimens had proceeded to such an extent that they were uniformly coated with a layer of graphite about one millimeter thick. The graphite-coated cast iron electrodes were then washed clean and dried in air. Both the graphite-coated and the clean cast iron specimens were of the same size, approximately 5 x 2 x 0.6 cm., and thus had the same superficial area.

The galvanic current flowing between the two electrodes when they were immersed in aerated 3.5 per cent sodium chloride solution is plotted in Fig. 2. The potentials against a saturated calomel cell of each electrode and of normally corroding specimens are plotted in Fig. 3. The weight losses of all the specimens and the calculated corrosion rates are given in the Table.

From the weight losses it is evident that the corrosion rate of clean cast iron was increased from the normal rate of 227 mg. per sq. dm. per day to 368 m.d.d. by coupling it with an equal superficial area of graphite-coated cast iron. The galvanic corrosion as calculated from the average galvanic current was 176 m.d.d. However, the galvanic current initially was very high, dropped rapidly, and approached a constant value of 0.97 milliamperes (see Fig. 2). The galvanic corrosion rate calculated from this constant current was 90 m.d.d. The drop in the galvanic current was due primarily to the potential of the graphite-coated electrode becoming less noble as the experiment progressed (Fig. 3). This decrease in nobility was due to polarization by cathodically deposited hydrogen.

The results indicate that the corrosion rate of clean cast iron in 3.5 per cent sodium chloride solution may be increased by more than one-third by placing it in contact with an equal area of graphite-coated cast iron. If the area of graphite-coated cast iron is larger, the galvanic corrosion will also be greater. This is quite likely to be the case in practice where a worn out part is replaced with a new one. Increasing the thickness or decreasing the porosity of the graphite coating would also tend to increase the galvanic current.

In the present experiment the graphite-coating protected the underlying iron. The normal corrosion rate of clean cast iron was 227 m.d.d. while that of graphite-coated cast iron was 33 m.d.d.

Alloyed Cast Iron Coupled with Graphitized Cast Iron

Since the magnitude of the galvanic current depends on the difference in potential between the graphite-coated electrode and the clean metal electrode, an effective means of reducing the galvanic corrosion would be to increase the nobility of the iron matrix by the addition of relatively large percentages of nickel or nickel and copper. To illustrate this effect an experiment was made in which the clean metal specimens were an austenitic cast iron (Ni-Resist), while the graphite-coated cast iron electrodes were prepared in the same manner as described above. The Ni-Resist contained by analysis 3.25 per cent total carbon, 1.88 silicon, 13.88 nickel, 6.35 copper, 2.80 chromium, and 1.07 manganese. The results obtained from this experiment are given in the Table and in Figs. 2 and 3.

The Ni-Resist proved sufficiently noble to cause the galvanic current to reverse in direction, the graphite-coated cast iron corroding and the clean Ni-Resist being protected. The corrosion rate of the graphite-coated cast iron increased from the normal rate of 33 m.d.d to 102 m.d.d., and the corrosion rate of the clean Ni-Resist decreased from the normal rate of 70 m.d.d. to 23 m.d.d. The average galvanic corrosion of the graphite-coated cast iron as calculated from the average galvanic current was 55 m.d.d.

As in the previous experiment the potential of the graphite-coated cast iron electrode was originally quite noble, causing a large current to flow in such a direction that the Ni-Resist corroded. However, the potential of the graphite-coated cast iron electrode rapidly became less noble and the current soon reversed in direction. The experiment was carried on sufficiently long so that the average galvanic current was in such a direction as to corrode the graphite-coated cast iron. The final constant galvanic current, which is more indicative of the results to be expected in practice, shows a galvanic corrosion rate of the graphite-coated cast iron of 49 m.d.d.

The results indicate that there is little danger of the corrosion rate of Ni-Resist being accelerated when it is placed in contact with graphite-coated cast iron. However, it is to be expected that the area, thickness, and porosity of the graphite coating will affect the galvanic corrosion. It is possible that a large area of graphite-coated cast iron, on which the graphite coating is very thick and thoroughly plugged with corrosion product, might have a sufficiently noble potential to accelerate the corrosion rate of Ni-Resist. In any case the galvanic corrosion of clean Ni-Resist would be much less than that of correspondingly exposed clean cast iron.

Ni-Resist Coupled with Graphite-Coated Ni-Resist

Of interest is the galvanic corrosion occurring between graphite-coated Ni-Resist and clean Ni-Resist. The graphite-coated specimens were prepared by immersing Ni-Resist in 28 deg. Baumé phosphoric acid, containing small amounts of sulphuric acid, nitric acid, and fluorides, until a layer of graphite was formed about 0.5 mm. thick. The graphite-coated electrodes were then washed clean and dried in air. The graphite-coated and the clean Ni-Resist specimens were of the same size, approximately 8 x 2.5 x 0.3 cm., and thus had the same superficial area. The results obtained by coupling these electrodes are given in the Table and in Fig. 2. Somewhat larger electrodes were used in these experiments because it was anticipated that the galvanic corrosion would be less than in the case of cast iron.

From the weight losses obtained it is apparent that the corrosion rate of the clean Ni-Resist was increased from the normal rate of 70 m.d.d. to 91 m.d.d., while the corrosion rate of the graphite-coated Ni-Resist dropped from 40 to 24 m.d.d. As in the previous cases the initial galvanic current was very high, but it dropped rapidly to a low value. The final constant current indicated a galvanic corrosion rate of only 5 m.d.d.

The results indicate that the galvanic corrosion of clean Ni-Resist coupled with graphite-coated Ni-Resist is small as compared with the galvanic corrosion of cast iron under similar conditions. The actual magnitude of the galvanic corrosion will depend on the area, thickness, and porosity of the graphite-coating.

In the present experiment the graphite-coating protected the underlying Ni-Resist. The normal corrosion rate of clean Ni-Resist was 70 m.d.d. while that of the graphite-coated Ni-Resist was 40 m.d.d.

Experiments with Cast Iron Graphitically Corroded in the Field

The above experiments were made with graphite-coated specimens prepared in the laboratory. It is of interest to compare the results with those obtained by using cast iron which had suffered graphitic corrosion in the field. Graphite-coated specimens were obtained from a cast iron plug cock which had been exposed to sea water for only a few months. The degree of graphitic corrosion occurring on the plug cock is shown in Fig. 1. The sea water was said to contain dissolved carbon dioxide and traces of chlorine. The cast iron showed upon analysis 3.2 per cent total carbon, 2.3

silicon, 0.08 sulphur, and 0.56 manganese. The analysis of the graphitic layer was as follows:

	Per Cent	
H_2O	11.6	
SiO_2	5.0	
R_2O_3	68.5	(Fe_2O_3 approximately 66.0)
SO_3	2.0	
C	11.2	
CaO	0.5	

When these graphite-coated cast iron specimens were coupled with clean cast iron, results were obtained in good agreement with those already reported. In the present instance the initial galvanic current was 66 milliamperes (equivalent to about 6,900 m.d.d.) and the final constant galvanic current was 1.00 milliamperes, which was equivalent to a galvanic corrosion rate of the clean cast iron of 105 m.d.d.

When the graphite-coated cast iron specimens were coupled with clean Ni-Resist, it was found that the direction of the galvanic current depended upon the porosity of the graphite. When the pores were clogged with corrosion product the Ni-Resist was anodic, but when they had been cleaned with acid, the graphite-coated cast iron became anode. This emphasizes what has already been said about the importance of the thickness and porosity of the graphite-coating. Clogging the pores in a graphite layer may be beneficial in avoiding corrosion of the underlying iron, but it also serves to increase the galvanic acceleration of corrosion of clean metal with which it may be in contact in a corrosion solution.

The potential of the graphite-coated cast iron electrode against a saturated calomel cell depended on the porosity of the graphite coating. When the pores were clogged with corrosion product, the potential of this electrode, after exposure to 3.5 per cent sodium chloride solution for two weeks while in galvanic contact with clean Ni-Resist, was 0.39 volts. Under similar conditions when the pores had been cleaned with acid the potential was 0.51 volts. The corresponding potential shown in Fig. 3 is 0.60 volts. These differences in potential suggest the possibility of estimating the porosity of the graphite coating, and its probable protective value, by measurement of its potential with respect to a standard electrode.

Application of Data

THE data which have been assembled above suggest practical means for reducing the types of corrosion discussed. It is quite often true that the casing of cast iron centrifugal pumps outlasts the impeller and it is common practice to install new cast iron impellers in old cast iron casings. If the casing has suffered graphitic corrosion, the rate of corrosion of the new impeller may be accelerated appreciably by its galvanic contact with the more noble graphite layer on the casing. This galvanic effect may serve to account for the occasional complaint that replacement impellers do not last as long as the original impellers in cast iron pumps. The results of this study indicate that such complaints may be avoided by using austenitic cast iron impellers for replacement, since the potential between Ni-Resist and a graphite-coated casing will either be of negligible magnitude, or in a direction to protect the former.

Similarly, where erosion prevents the accumulation of graphite on the impellers, but not on the casing, it should be good practice to use Ni-Resist impellers in the original installation so as to avoid galvanic corrosion between impeller and graphitized casing.

It is possible to avoid graphitic corrosion in many cases by refining the grain, reducing the graphite particle size, and increasing the soundness of cast iron through the use of relatively small amounts of alloying elements. Such improvement in the structure of the iron tends to reduce the depth to which corrosion can penetrate readily, and indirectly limits the extent of graphitic corrosion. This effect is illustrated by some field tests in a fatty acid still under conditions favoring graphitic corrosion. The duration of the test was 1836 hrs., and the following results were obtained:

	Analysis					Corrosion Rate in Inches Penetration Per Year
Material	T.C.	Si	Ni	Cu	Cr	
Unalloyed cast iron	3.02	1.82	...	..	...	0.374
Nickel cast iron	2.89	1.24	3.58	..	...	0.168
Nickel-chromium cast iron	3.03	2.16	2.73	..	1.25	0.147
Ni-Resist	...	...	14.62	6	2.34	0.018

The superior performances of the cast irons containing relatively small percentages of nickel, or nickel and chromium, were probably due more to the effects of the alloying elements in improving the structure of the iron than to any specific effects on its inherent corrosion resistance. Similar beneficial effects of small percentages of nickel have been observed in alloy irons used in deep well pumps and in water jacketed cylinders and cylinder liners. On the other hand, the high degree of corrosion resistance shown by the austenitic iron was probably due principally to the ennobling effect of its relatively high alloy content.

References

[1] *Transactions,* American Electrochemical Society, Vol. 54, 1928, page 163.

[2] *Mitteilungen aus dem königlichen Materialprüfungsamt,* Vol. 36, 1918, page 114.

[3] *Industrial & Engineering Chemistry,* Vol. 25, 1933, page 59.

[4] *Industrial & Engineering Chemistry,* Vol. 19, 1927, page 337.

Editorial Comment

(*Continued from page A25*)

by Chevenard, but more clearly by Brophy, may not be far-fetched. Thus it is possible that a high temperature damping test might serve to pick out high and low creep-resistance material to a useful degree. One should be cautious against jumping to that conclusion, but at least the lead opened by Brophy ought to be vigorously followed up.—H. W. G.

Sponge Iron

IF one analyzes carefully the Government statistics of American imports and exports of iron and steel, there is often detected certain trends which are interesting both from a commercial and metallurgical viewpoint. This is particularly true of the imports of sponge iron.

Reviewing the data of imports of this material over a period of years, the following table can be compiled (figures in gross tons):

Year	Total Imports	Tons per Month
1931	216	17.5
1932	185	15.4
1933	619	51.0
1934	898	75.0
1935	1,460	120.0
1936 (8 mos.)	1,380	172.5

These data reveal the fact that there has been almost a continuous increase in receipts of this material in the last six years. At 172.5 tons per month thus far in 1936, the volume has attained record proportions. Previous to 1931 these imports were negligible. This imported material is practically all from Sweden where there exists a special process for producing it. Thus, in spite of the depression, the demand has expanded to fairly substantial proportions.

There are at present several metallurgical applications of sponge iron. One is the introduction of certain percentages in the raw material charges of elastic and other furnaces producing high grade steels. It is claimed that a better steel is obtained by this procedure. A still more interesting and rapidly expanding use is in powder metallurgy. Sponge iron in powdered form is gradually being introduced into bearings and as an ingredient in special alloys, produced by subjecting various compositions to high pressures followed by carefully regulated sintering or heating. One automobile company is a pioneer and leader in this field.

Attempts to produce sponge iron in this country have not been commercially successful, due largely to the difficulty of producing a product of requisite purity and physical characteristics. Electrolytic iron powder has the purity but not the desired structure. Many processes have been developed and patented. It is believed that there is an expanding field for such a material and that in time it will be available to industry on a larger scale. The fact that fine ore can be thus utilized is in its favor.—E. F. C.

Readers' Comments on Salt Baths

We have received from A. Linley, chief metallurgist, Darwin's Ltd., Sheffield, England, some comments on the article by E. F. Davis in our June issue on cyanide and activated electric salt bath heating processes. These comments are too lengthy to give in full, but some of the salient points are summarized below.

Darwin's has been well satisfied with the performance of three salt bath furnaces, one of which has been in use for 15 yrs. Heat resisting, L-shaped electrodes of the full cross-section of the bath are used, one on each side of the bath. The bath is held in refractories, which are in contact with the salt, instead of in an iron vessel. With such electrodes, close spacing is avoided, since the electrodes warp at the higher operating temperatures. (Heavy, close-spaced electrodes of properly chosen materials, as used in this Ajax-Hultgren type are reported not to warp. This is no doubt due to the fact as stated by Davis that there is practically uniform temperature throughout the bath, including the space between the electrodes. This circulation is said to be due to the action of electromagnetic forces.—Ed.) The largest outfit at Darwin's is a 50 k.w. furnace 22 x 18 in., 22 in. deep, bath dimensions, used for hardening tools, etc., at 800 to 1020 deg. C., a slightly smaller one is used for tempering at 500 to 600 deg. C., and a tiny 10 k.w. furnace is used for high speed at around 1350 deg. C. At one time a bath 5 ft. deep was in use for roll hardening. During normal idle periods, the current is cut down and the temperature held just above the melting point of the bath. For longer shutdowns the current is taken off and the furnace restarted when required, by striking an arc along the surface of the salt by an iron poker. (Such a furnace was in use in the United States 28 yrs. ago and a small number of such furnaces are still in use.—Ed.)

These furnaces do not have the electrodes so placed as to set up the circulation of the bath that is the feature of the furnace described by Mr. Davis, yet, according to Mr. Linley, circulation and temperature distribution are considered satisfactory, though the bath is hotter close to the electrodes. The electrodes reach nearly to the bottom of the bath, and scale from the work is dissolved or suspended in the bath, forming a highly conductive layer on the bottom which has, in experimental operation, above the usual operating temperature, actually caused fusion of the bottom of the electrodes. (This would seem to indicate a lack of active circulation.—Ed.) The conducting layer must be dredged out from time to time. (In the furnace described by Mr. Davis, the electrodes do not extend to the bottom of the bath.—Ed.)

Mr. Linley emphasizes that a straight salt bath is not foolproof in regard to soft skin, but that the constant addition of small amounts of cyanide is necessary. Exhaust hoods are needed to keep fumes from attacking electrical contacts. At 950 to 1000 deg. C. no protection tube for platinum couples has been found that will stand up, so optical pyrometers, checked now and then by inserted thermocouples, are used for control. Mr. Linley points out that unless these particular features of salt bath work are properly attended to, an excellent method may be rejected by new users.

A. E. Bellis, The Bellis Heat Treating Co., Branford, Conn., who has marketed the "Lavite" electric salt bath furnace of which many are in operation, some being of very large size, comments in regard to the Davis article and the Linley information that most of the difficulties met by Mr. Linley are, in his opinion, due to holding the salt in a refractory hearth instead of in a metal container. Breakdown of the bath so that a soft skin results on the work is less, according to Bellis, when the salt is held in metal, and this in turn minimizes the fumes and the attack upon pyrometer sheaths. He says: "The fact that these metallic containers obviate the deterioration of the bath and consequent deleterious effect on the work has been well established on a wide range of applications of these furnaces from tempering temperatures of 300 deg. F. to the high speed hardening temperature of 2300 deg. F. and also on large annealing and heat-treating baths up to 30 ft. long with pot and salt bath up to 30,000 lbs." On larger installations than those in use at Darwin's, he prefers a resistance coil placed between the electrodes for starting up. In cases where there is ample space, the coil may be left permanently installed.

We are indebted to Mr. Linley and Mr. Bellis for these helpful comments.

METALS AND ALLOYS

CLEVELAND
OHIO

18th NATIONAL METAL EXPOSITION

Floor Plan • Exhibitors • Society Programs • New Products

PREVIEW

ANNOUNCING

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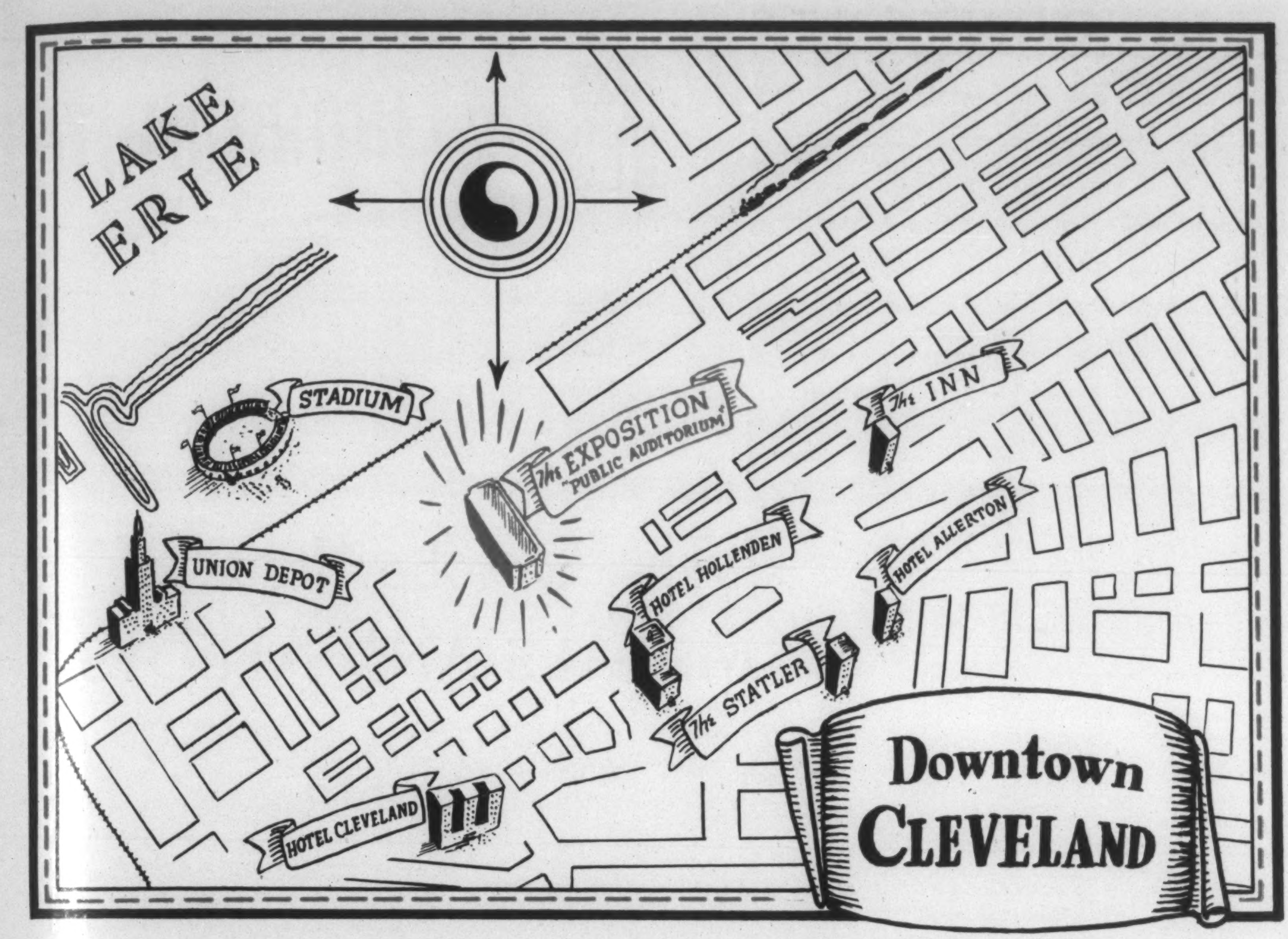
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The Eighteenth National Metal Congress and Exposition

EVERY INDICATION POINTS to the probability that the Eighteenth National Metal Congress—the National Metal Exposition and Convention, sponsored by the American Society for Metals—scheduled for Cleveland, Oct. 19 to 23, will be the largest and most successful on record.

As in the recent past, four other technical organizations will participate—the American Welding Society, the Iron and Steel and the Institute of Metals Divisions of the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the Wire Association. The combined efforts of these five societies have established the Congress as a national institution.

The A.S.M. alone has provided about 57 lectures and technical papers which, in conjunction with those of the other organizations, will swell the total to well over 100. Detailed programs follow on other pages.

The Metal Exposition will be housed in Cleveland's spacious Public Auditorium. A total of over 225 exhibitors will participate. A list of them and what they will exhibit also follows.

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Exhibitors and What They Will Present P28-P60

The October Issue of METALS AND ALLOYS

ARTICLES ON A VARIETY of metallurgical engineering subjects, both ferrous and non-ferrous, are offered readers of Metals and Alloys in its October, or Pre-Convention, issue.

In the form of a correlated abstract Dr. H. W. Gillett, editorial director, presents a discussion of developments in the metallurgy of rail steels during the last 25 years. It is a comprehensive review of this important subject and deals with the latest activities in the heat treatment of rails.

A subject which has whetted the interest of many metallurgists and heat treaters is the process used by the Gillette Safety Razor Co., of Boston, in hardening its razor blade steel by the use of inductive heat and magnetic control. Metals and Alloys takes some pride in the fact that it can present for the first time an exclusive article on this process by A. R. Stargardter, chief metallurgist of the company.

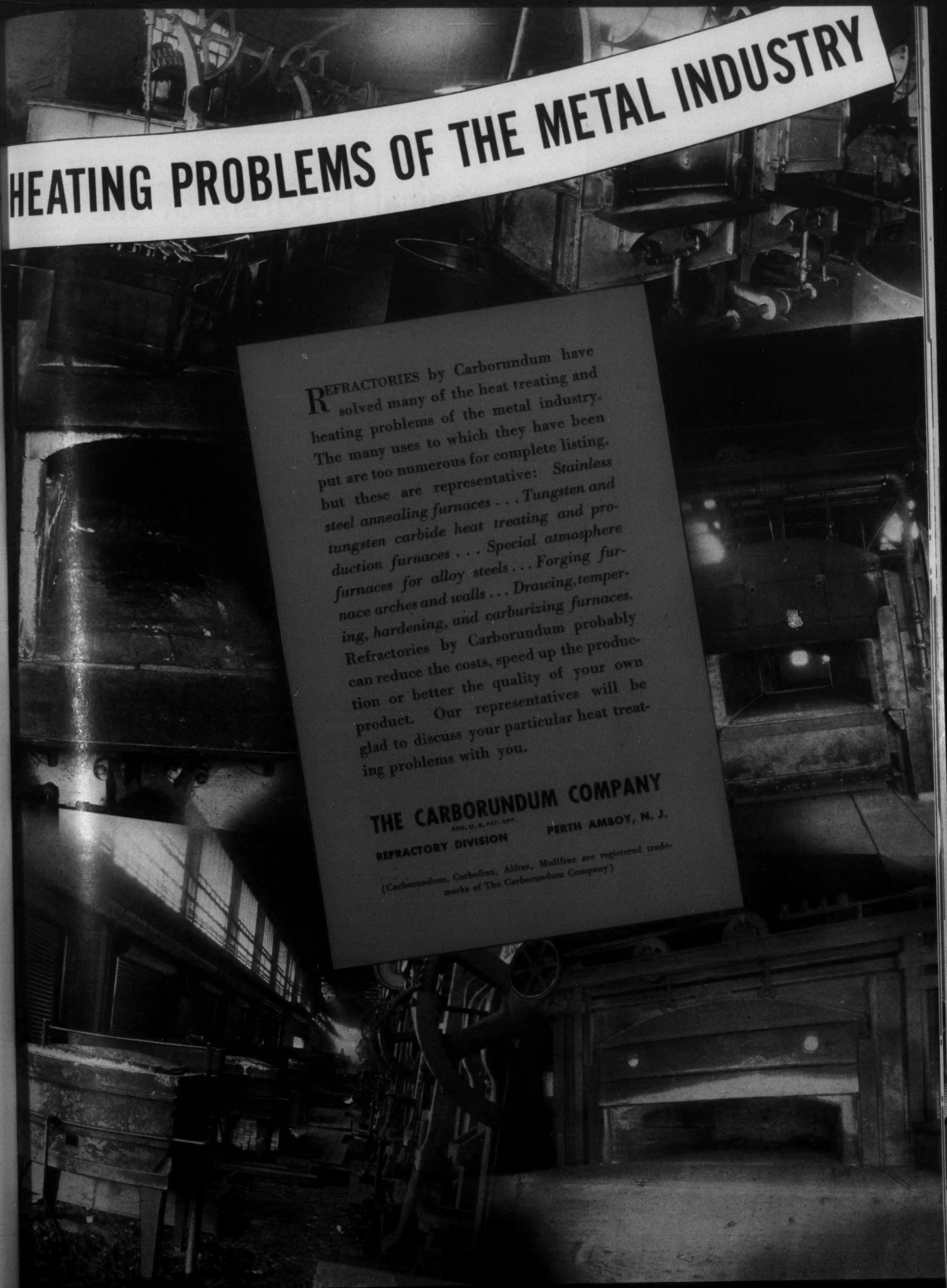
George F. Comstock, metallurgist of the Titanium Alloy Mfg. Co., Niagara Falls, N. Y., contributes a very interesting article in the non-ferrous field on the hardness and conductivity of copper castings alloyed with beryllium and titanium.

Other articles in the non-ferrous field include a discussion of the question of whether melting or pouring practice is chiefly responsible for defects in wrought brass by L. Kroll and E. A. Anderson, metallurgists of the Dallas Division of Revere Copper & Brass, Inc., and one by L. R. van Wert of Harvard University and B. W. Gonser of Battelle Memorial Institute, on lattice changes due to heat treatment in certain age-hardenable copper alloys.

The issue also contains the second and concluding portion of the article on metallurgical needs of the glass industry, by R. D. Smith of the Corning Glass Works, Corning, N. Y., supplemented by some comments by other authorities in the glass industry.

In the plating field there is offered an interesting discussion of bright nickel plating by A. H. Beebe of the engineering laboratories of the Chrysler Corp., Detroit.

Other articles include a description of an installation of automatic machines for carburizing using gas and also a modern batch gas carburizing operation.



HEATING PROBLEMS OF THE METAL INDUSTRY

REFRACTORIES by Carborundum have solved many of the heat treating and heating problems of the metal industry. The many uses to which they have been put are too numerous for complete listing, but these are representative: *Stainless steel annealing furnaces . . . Tungsten and tungsten carbide heat treating and production furnaces . . . Special atmosphere furnaces for alloy steels . . . Forging furnace arches and walls . . . Drawing, tempering, hardening, and carburizing furnaces.* Refractories by Carborundum probably can reduce the costs, speed up the production or better the quality of your own product. Our representatives will be glad to discuss your particular heat treating problems with you.

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R. S. Archer
Pres. of A. S. M.

Technical Program of the American Society for Metals

THE TECHNICAL PROGRAM of the American Society for Metals is always an outstanding feature of the National Metal Congress. This year is no exception. The program is tentatively announced as consisting of approximately 57 lectures and papers, dealing with practically every important phase of metallurgical engineering and of the metal industry. According to President Archer, "the program gives the society the largest and most comprehensive list of talks ever scheduled, exceeding even last year's sessions. The morning papers will be presented at the society's headquarters, the Hotel Statler; in the afternoon, at the Auditorium.

As in the last year or two, special lectures have been provided. Last year the series on "Heat Treatment of Steel" by Dr. M. A. Grossman and on "Spectrographic Analysis" by E. J. Martin were signal successes. For 1936 the two special lecturers are Prof. H. D. Churchill, professor of mechanics at Case School of Applied Science, Cleveland, who will present each afternoon at 4:30 a series on "Physical Testing of Metals," and Dr. Kent R. Van Horn, metallurgist of the Aluminum Co. of America, Cleveland, who will deliver three evening lectures on "X-Rays Analysis."

The program is so large that simultaneous sessions have had to be provided. These will occur on Tuesday, Thursday and Friday mornings and on Thursday and Friday afternoons. A special feature is a two-day symposium on the "Plastic Working of Metals" at which about 20 papers by authorities in this field are scheduled.

The technical program is substantially as follows:

Monday, Oct. 19

Morning

"Retarding Effect of Certain Metallic Elements on Graphitization," by H. A. Schwartz, H. H. Johnson and C. H. Junge, National Malleable & Steel Castings Co., Cleveland.

"Cadmium Alloys for Bearings," by C. F. Smart, Pontiac Motor Co., Pontiac, Mich.

"Diffusion of Hydrogen through Nickel and Iron," by W. R. Ham, Pennsylvania State college, State College, Pa.

"Behavior of Quenching Mediums During Quenching," a high-speed motion picture, by I. N. Zavarine, Massachusetts, Institute of Technology, Cambridge, Mass.

Afternoon

"Notes on Continuous Gas Carburizing," by R. J. Cowan, Surface Combustion Corp., Toledo, O.

"Differential Hardening by Induction," by M. A. Tran and W. E. Benninghoff, Ohio Crankshaft Co., Cleveland.

"Continuous Heat Treatment of Cold-Rolled Strip," by N. P. Goss, Cold Metal Process Co., Youngstown, O., and T. B. Bechtel, Electric Furnace Co., Salem, O.

Educational Course: "Physical Testing of Metals," lecture No. 1, by H. D. Churchill, professor of mechanics, Case School of Applied Science, Cleveland.

Evening

Educational Course: "X-Ray Analysis," lecture No. 1, by Kent R. Van Horn, metallurgist, Aluminum Co. of America, Cleveland.

Tuesday, Oct. 20

Morning

"Some Effects of Small Additions of Vanadium to Eutectoid Steel," by J. G. Zimmerman, R. H. Aborn and E. C. Bain, United States Steel Corp., Kearny, N. J.

"Influence of Aluminum on the Normality and Grain Size of Steel," by G. R. Brophy and E. R. Parker, General Electric Co., Schenectady, N. Y.

"A Study of the Effect of the Aluminum Addition on the Structure of a Quenched Carbon Steel," by H. W. McQuaid, Republic Steel Corp., Massillon, O.

Simultaneous Session

"Effect of Titanium on Some Cast Ferrous and Nonferrous Metals," by J. A. Duma, Norfolk Navy Yard, Portsmouth, Va.

"Effect of Titanium on the Hardness and Microstructure of Heat Treated 18 Per Cent Chromium Steel Ingots," by R. E. Bannon, Titanium Alloy Mfg. Co., Niagara Falls, N. Y.

"Production of Flakes in Steel by Heating in Hydrogen," by R. E. Cramer, University of Illinois, Urbana, Ill.

AFTERNOON

"Effect of Overload on the Fatigue Properties of Several Steels at Various Low Temperatures," by H. B. Wishart and S. W. Lyon, University of Illinois, Urbana, Ill.

"Austenitic Stainless Alloys: Their Properties and Characteristics," by V. N. Krivobok and R. A. Lincoln, Allegheny Steel Co., Brackenridge, Pa.

"Slip Twinning and Cleavage in Iron and Silicon Ferrite," by C. S. Barrett, G. Ansel and R. F. Mehl, Carnegie Institute of Technology, Pittsburgh.

Educational Course: "Physical Testing of Metals," lecture No. 2, by H. D. Churchill.

EVENING

Educational Course: "X-Ray Analysis," lecture No. 2, by Kent R. Van Horn.

Wednesday, Oct. 21

MORNING

Annual meeting of American Society for Metals.

Campbell Memorial Lecture, by J. P. Gill, metallurgist, Vanadium-Alloys Steel Co., Latrobe, Pa.

AFTERNOON

"Magnetic Properties of a Series of Basic Open-Hearth Slag Samples," by B. A. Rogers and K. O. Stamm, United States Bureau of Mines, Pittsburgh.

"Basic Open-Hearth Slag Control," by Earnshaw Cook, American Brake Shoe & Foundry Co., Chicago Heights, Ill.

"A New Tool for Control of Quality Steelmaking," by G. T. Motok, Republic Steel Corp., Cleveland.

"Equilibrium in the Reaction of Hydrogen with Iron Sulphide in Liquid Iron and the Thermodynamics of Desulphurization," by John Chipman and Ta Li, American Rolling Mill Co., Middletown, O.

Educational Course: "Physical Testing of Metals," lecture No. 3, by H. D. Churchill.

EVENING

Educational Course: "X-Ray Analysis," lecture No. 3, by Kent R. Van Horn.

Thursday, Oct. 22

MORNING

Symposium on "Plastic Working of Metals."

Simultaneous Session

"X-Ray Study of Preferred Oirentations in Pure Cold-Rolled Iron-Nickel Alloys," by D. McLachlan Jr. and W. P. Davey, Pennsylvania State college, State College, Pa.

"Application of X-Ray Diffraction to the Study of Fatigue in Metals," by C. S. Barrett, Carnegie Institute of Technology, Pittsburgh.

"X-Ray Diffraction Studies of Distortion in Metals," by G. L. Clark and M. M. Beckwith, University of Illinois, Urbana, Ill.

AFTERNOON

Symposium on "Plastic Working of Metals" (continued).

Simultaneous Session

"Further Study of a High-Carbon, High-Chromium Tool Steel," by W. H. Wills, Ludlum Steel Co., Dunkirk, N. Y.

"Importance of Boundary Attack in the Etching of Steel Specimens," by B. L. McCarthy, Wickwire Spencer Steel Co., Buffalo.

"Physical Properties of Axle Shafts," by H. B. Knowlton, International Harvester Co., Chicago.

Educational Course: "Physical Testing of Metals," lecture No. 4, by H. D. Churchill.

Friday, Oct. 23

MORNING

Symposium on "Plastic Working of Metals" (continued).

Simultaneous Session

"Conversion of Elongation Data from One Form of Test Piece to Any Other," by E. J. Janitzky, Carnegie-Illinois Steel Corp., Chicago.

"Behavior of Some Low-Alloy Steels in the Single-Blow Drop Test," by O. W. Ellis, Ontario Research Foundation, Toronto, Ont.

"Fracture of Carbon Steel at Elevated Temperatures," by A. E. White and C. L. Clark, University of Michigan, Ann Arbor, Mich., and R. L. Wilson, Timken Steel & Tube Co., Canton, O.

(Continued on page P 89)

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Technical Program of the American Welding Society

ARRANGEMENTS ARE COMPLETED for the seventeenth annual meeting of the American Welding Society in Cleveland, Oct. 19 to 23, in conjunction with the National Metal Congress. A program of about 25 technical papers has been scheduled which will be fully up to the high standard maintained at former meetings. The headquarters of the society will be at the Hotel Cleveland where the technical sessions will be held.

The technical sessions on Monday, Tuesday and Wednesday, Oct. 19, 20 and 21, will be exclusively those of the A. W. S. On Thursday, Oct. 22, there will be two joint sessions, morning and afternoon, with the American Society of Mechanical Engineers. The program for Friday, Oct. 23, is that of the A. S. M. E. with the members of the A. W. S. invited and cooperating.

The technical program for these sessions is substantially as follows:

Monday, Oct. 19

Morning: Business Session:

President J. J. Crowe, presiding

Report on society activities by President Crowe.

Teller's report on election of officers.

Award of Samuel Wylie Miller Memorial Medal.

Review of committee and section activities by chairmen.

Discussion.

Afternoon: Technical Session:

A. E. Gibson, *Chairman*, The Wellman Engineering Co.

E. Vom Steeg, *Vice-Chairman*, General Electric Co.

Welcome address by local official.

"Fundamentals of Metallurgy of Welding," by E. S. Davenport and Dr. R. H. Aborn, United States Steel Corp.

"Multi-Layer Oxyacetylene Pipe Welding," by R. M. Rooke, F. C. Saacke and A. N. Kugler, Air Reduction Sales Co.

High speed motion pictures of various welding processes, by E. Vom Steeg, General Electric Co.; W. E. Crawford and Walter Richter, A. O. Smith Corporation.

Evening: Dinner and Meeting Board of Directors:

Review of society activities, appointment of committees and officers, new business.

Tuesday, Oct. 20

Morning: Technical Session:

H. M. Boylston, *Chairman*, Case School of Applied Science.

E. R. Fish, *Vice-Chairman*, The Hartford Steam Boiler Inspection & Insurance Co.

Fundamental Research in Welding:

"Heating by the Proximity Effect," by Edward Bennett, The University of Wisconsin.

"The Welding of Copper," by A. P. Young, Michigan College of Mining and Technology.

"Non-Destructive Testing of Welds," by W. B. Kouwenhoven, The Johns Hopkins University.

"Impact Tests of Welds at Low Temperatures," by Otto Henry, Brooklyn Polytechnic Institute.

Afternoon: Technical Session:

H. W. Gillett, *Chairman,* Battelle Memorial Institute.
R. E. Kinkead, *Vice-Chairman,* Consulting Engineer.

Fundamental Research in Welding:

"X-Ray Methods for Studying Stress Relief," by John T. Norton, Massachusetts Institute of Technology.

"Welded Beam-Column Connections," by Inge Lyse, Fritz Engineering Laboratory, Lehigh University.

"Circuit Characteristics and Arc Stability," by S. C. Osborne, Wilson Welder and Metals Co., Inc.

"Welded Structural Brackets," by C. D. Jensen, Lehigh University.

Evening: Conference and Meeting of Fundamental Research Committee, Bureau of Welding Research and Engineering Foundation:

H. M. Hobart, *Chairman,* General Electric Co.

This conference is scheduled for university research workers in the fundamentals of welding.

Wednesday, Oct. 21

Morning: Technical Session:

A. F. Davis, *Chairman,* The Lincoln Electric Co.
C. A. McCune, *Vice-Chairman,* Magnaflux Corp.

"Brazing with Silver Solders," by Robert H. Leach, Handy & Harman.

"Importance of Design Control for Welded Piping Systems," by T. W. Greene, Linde Air Products Co.

"Principles of Surfacing by Welding," by E. W. P. Smith, The Lincoln Electric Co.

"Technique for Resistance Welding Ferrous and Non-Ferrous Sheet Metals," by E. I. Larsen, P. R. Mallory Co.

Afternoon: Technical Session:

Hugh H. Dyar, *Chairman,* The Linde Air Products Co.
J. B. Tinnon, *Vice-Chairman,* Metal and Thermit Corp.

"Procedures for Control of Welding Parts," by G. H. Moore, Jr., Newport News Shipbuilding and Dry Dock Co.

"Welding Copper and Its Alloys—A Review of the Literature," by Ira T. Hook, American Brass Co.

"Resistance Welding of Dissimilar Metals," by R. T. Gillette, General Electric Co.

"Thermit Welding," by J. H. Deppeler, Metal & Thermit Corp.

"The Exploration of the Modern Metallic Arc," by L. J. Larson, A. O. Smith Corp.

Thursday, Oct. 22

Morning: Joint Session American Welding Society with American Society of Mechanical Engineers:

C. W. Obert, *Chairman,* Union Carbide & Carbon Research Labs., Inc.
Milton Male, *Vice-Chairman,* United States Steel Corp.

"Stress Analysis," by C. H. Jennings, Westinghouse Elec. & Mfg. Co.

"Alloy Steels and Their Weldability," by A. B. Kinzel, Union Carbide and Carbon Research Labs.

Afternoon: Joint Session American Welding Society with American Society of Mechanical Engineers:

H. F. Henriques, *Chairman,* Air Reduction Sales Co.
S. M. Weckstein, *Vice-Chairman,* Timken Roller Bearing Co.

"Welding Heavy Machinery and Equipment," by C. A. Wills and F. L. Lindemuth, Wm. B. Pollock Co.

"Steel Plate Construction."

"Using Steel Plates for Machine Frames."

Evening: Dinner dance with entertainment:

Friday, Oct. 23

Morning: American Society of Mechanical Engineers:

(American Welding Society members invited.)

Weldability of Non-Ferrous Metals:

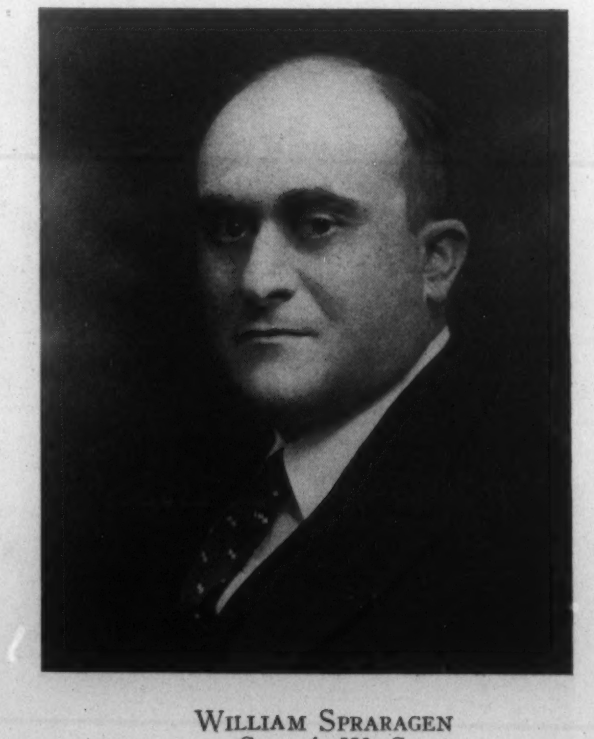
Copper, Brass and Bronze, Monel Metal, Aluminum.

Afternoon: American Society of Mechanical Engineers:

(American Welding Society members invited.)

Review of Welding Developments as they Affect Mechanical Design.
Welding of Light Machines and Products.
Principles Involved in Selecting Casting *vs.* Welding.

J. J. Crowe
Pres. A. W. S.



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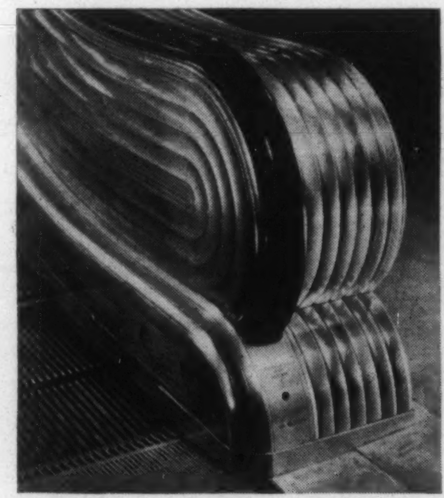

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CHAPTER III — CHEMICAL DIP FINISHES — Frosted Dip . . . Reflector Dip . . . Etching . . . Chemical Oxide Finishes . . . for paint base.

CHAPTER IV — ELECTROLYTIC OXIDE FINISHES — Alumilite Finishes (patented) . . . for abrasion resistance . . . for resistance to corrosion . . . colored . . . stain-proofed . . . Alzak Reflectors (patented) . . . Anodic Finishes in Chromic Acid.

CHAPTER V — ELECTROPLATING ON ALUMINUM — Zinc Plating . . . Chromium on Aluminum . . . Nickel on Aluminum . . . Other Metals . . . Black Nickel.

CHAPTER VI — ALCLAD PRODUCTS — Resistance to Corrosion.

CHAPTER VII — PAINT, ENAMEL, LACQUER FINISHES — Surface Preparation . . . Application . . . Priming Paints and Finishing Coats . . . Clear Finishes.

CHAPTER VIII — VITREOUS ENAMEL.

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Technical Program of the Wire Association

THE program for the Wire Association during the National Metal Congress comprises six technical sessions, a business meeting and an informal dinner, all to be held at the Hotel Cleveland. The program covers a wide range of subjects.

The Wire Association medal will be awarded at an informal dinner at the Mayfair Casino, Wednesday evening, Oct. 21.

Monday, Oct. 19

Morning

Registration.

Afternoon

Board of directors meeting.
Annual meeting.

Tuesday, Oct. 20

Morning

Cleaning—Heat Treating—Material Handling

"Cleaning Houses in the Wire Industry," by A. F. Anjeskey, sales manager, Cleveland Tramrail division, Cleveland Crane & Engineering Co., Wickliffe, O.

"Atmosphere Furnaces in the Wire Industry," by H. M. Heyn, engineer in charge of heat treating division, Surface Combustion Corp., Toledo, O.

Afternoon

Springs—Welding Wire

"Materials for Springs," by J. W. Rockefeller Jr., consulting engineer, New York.

"Welding Wire," by R. Notvest, chief engineer, welding division, J. D. Adams Co., Indianapolis.

Wednesday, Oct. 21

Morning

Research

"Research as Applied to Manufacturing," by C. W. Meyers, development engineer, American Steel & Wire Co., Cleveland.

"Wire Research by the United States Army," by Capt. Frank W. Bullock, signal corps, United States army.

Motion picture—"Signal Communication Within the Infantry Regiment."

Afternoon

Cold Working of Metal

"Plastic Deformation in Wire Drawing," by B. L. McCarthy, metallurgist, Wickwire Spencer Steel Co., Buffalo.

Evening

Informal dinner at Mayfair Casino.
Award of Wire association medal.

Thursday, Oct. 22

Morning

Testing Copper Wire—Power Cable

"Fatigue Properties of Copper Wire," by J. N. Kenyon, testing engineer, department of civil engineering, Columbia university, New York.

"Vacuum Lead Sheath as Applied to Power Cable," by R. W. Atkinson, research laboratory, General Cable Corp., Perth Amboy, N. J.

Motion picture—"Tactical Employment of the Antiaircraft Artillery Regiment."

Afternoon

Dies and Tools

"Tungsten Carbide," by A. R. Zapp, manager, Firthaloy division, Firth-Sterling Steel Co., McKeesport, Pa.

"A Suggested Method of Handling Tungsten Carbide Dies Within the Die Room," by K. R. Beardslee, general sales manager, Carboloy Co. Inc., Detroit.

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TUBING
CONNECTORS

The outstanding characteristics of OFHC COPPER are its freedom from oxygen and the uniformly fine quality of the castings produced by the Refinery.

Its freedom from oxygen gives OFHC COPPER greater ductility and toughness; making it especially well suited for all products which are subjected to severe fabricating or service conditions.

OFHC COPPER has greater resistance to impact stresses than ordinary electrolytic copper.

OFHC COPPER, because of its freedom from oxides, is better than ordinary electrolytic copper for welding and brazing.

OFHC COPPER conforms to the A.S.T.M. Specification, B5-27, for electrolytic copper wire bars, cakes, etc. with regard to metal content and resistivity and is free from cuprous oxide.

Schedules of weights and dimensions of OFHC shapes, and a booklet containing technical information will be sent promptly on request.

UNITED STATES METALS REFINING COMPANY
420 Lexington Avenue · · New York, N. Y.

JONES & LAUGHLIN STEEL

AT THE NATIONAL METAL EXPOSITION . . .

J & L Steel Products for Every Requirement

. . . Important Advantages for Every User

1 HOT ROLLED JALCASE

Excellent forging and heat-treating qualities. Available in three grades—.10/.20, .25/.35 and .30/.40 carbon. Ask the J & L Metallurgist at Booth E-15.

2 COLD FINISHED JALCASE

Provides exceptionally good machinability and excellent heat-treating qualities. Available in three grades—.10/.20, .25/.35 and .30/.40 carbon. Ask the J & L Metallurgist at Booth E-15.

3 FORGING STEEL

For uniform high quality forgings, fewer rejections, longer life of forging equipment and lower over-all cost. Ask the J & L Metallurgist at Booth E-15.

4 IMPROVED BESSEMER SCREW STEEL

Users have reported production increases ranging from 11% to 99%, longer tool life and improved quality of finished parts. Ask the J & L Metallurgist at Booth E-15.

5 COLD FINISHED SHAFTING

Reduces overhead, lengthens life of bearings, saves lining-up time and cuts manufacturing cost when used for working parts. Ask the J & L Metallurgist at Booth E-15.

6 WIDE COLD ROLLED FLATS

Adaptable to a wide variety of applications where the added strength, smooth finish, greater tensile value and hardness features of a cold finished product are desirable. Available in widths up to 12" and thicknesses up to 2½". See the J & L Exhibit, Booth E-15.

7 SPRING WIRE

For speedier production of high quality springs. Lends itself readily to coiling, crimping and other forming operations. Ask the J & L Metallurgist at Booth E-15.

8 COLD HEADING WIRE

For greater output and better quality parts. Used with excellent results for a wide variety of parts, from the simplest to the most complicated. Ask the J & L Metallurgist at Booth E-15.

9 TIN PLATE, Including Jalcold Quality

For better quality containers and closures, because it is uniform in quality, properly heat-treated and uniformly tinned. See the J & L Exhibit at Booth E-15.

10 HOT ROLLED BARS AND SHAPES

Made in a full range of sizes and a wide variety of carbon steel analyses. See the J & L Exhibit at Booth E-15.

11 COLD FINISHED BARS AND SHAPES

A complete line of rounds, squares, hexagons, flats and special shapes in all S.A.E. carbon grades. See the J & L Exhibit at Booth E-15.

YOLOY HIGH TENSILE STEEL

TO ACHIEVE MAXIMUM PAY-LOAD . . . to decrease weight without sacrifice of strength . . . to secure doubled strength without increase in weight . . . to gain 4 to 6 times increased resistance to corrosion . . . to simplify production through superior workability and weldability . . . these were the five major reasons leading to the selection of YOLOY for the wide variety of products illustrated on this page.

YOLOY, the high tensile nickel-copper alloy steel developed by Youngstown's Research Department and produced exclusively by YOUNGSTOWN, because of its low air-hardening property is particularly adaptable to modern welded construction. For complete description write for special YOLOY Bulletin.

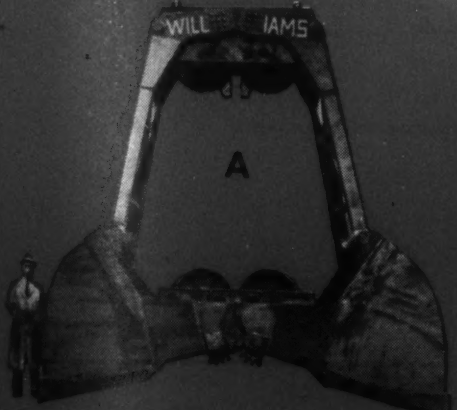
- a) 7-ton clamshell bucket
- b) Railway box-car sides
- c) Coal-hauling unit
- d) Streamlined passenger car
- e) Internal gear
- f) Fleet of delivery trucks
- g) Gasoline tank-truck

High-Tensile Steel **YOLOY** is available in sheets, strip, bars, plates, shapes, manufacturer's and welding wire, seamless and electric weld pipe.

THE YOUNGSTOWN SHEET & TUBE COMPANY
Manufacturers of Carbon and Alloy Steels
GENERAL OFFICES • YOUNGSTOWN, OHIO

See the Youngstown exhibit
at National Metal Show

YOLOY TRADE MARK YOUNGSTOWN STEEL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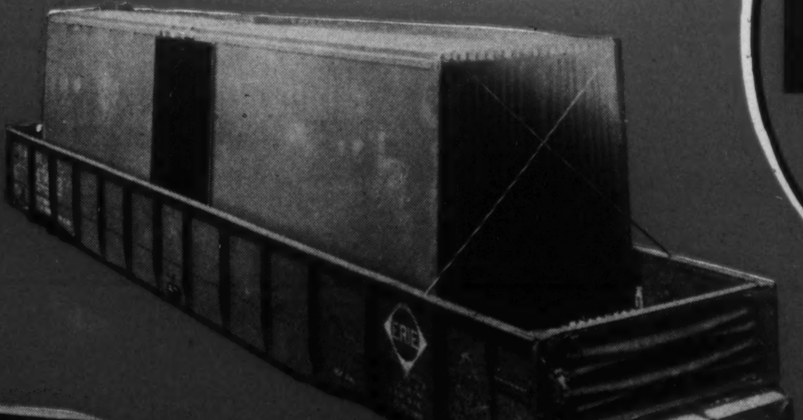
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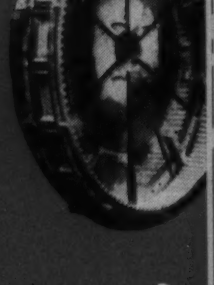
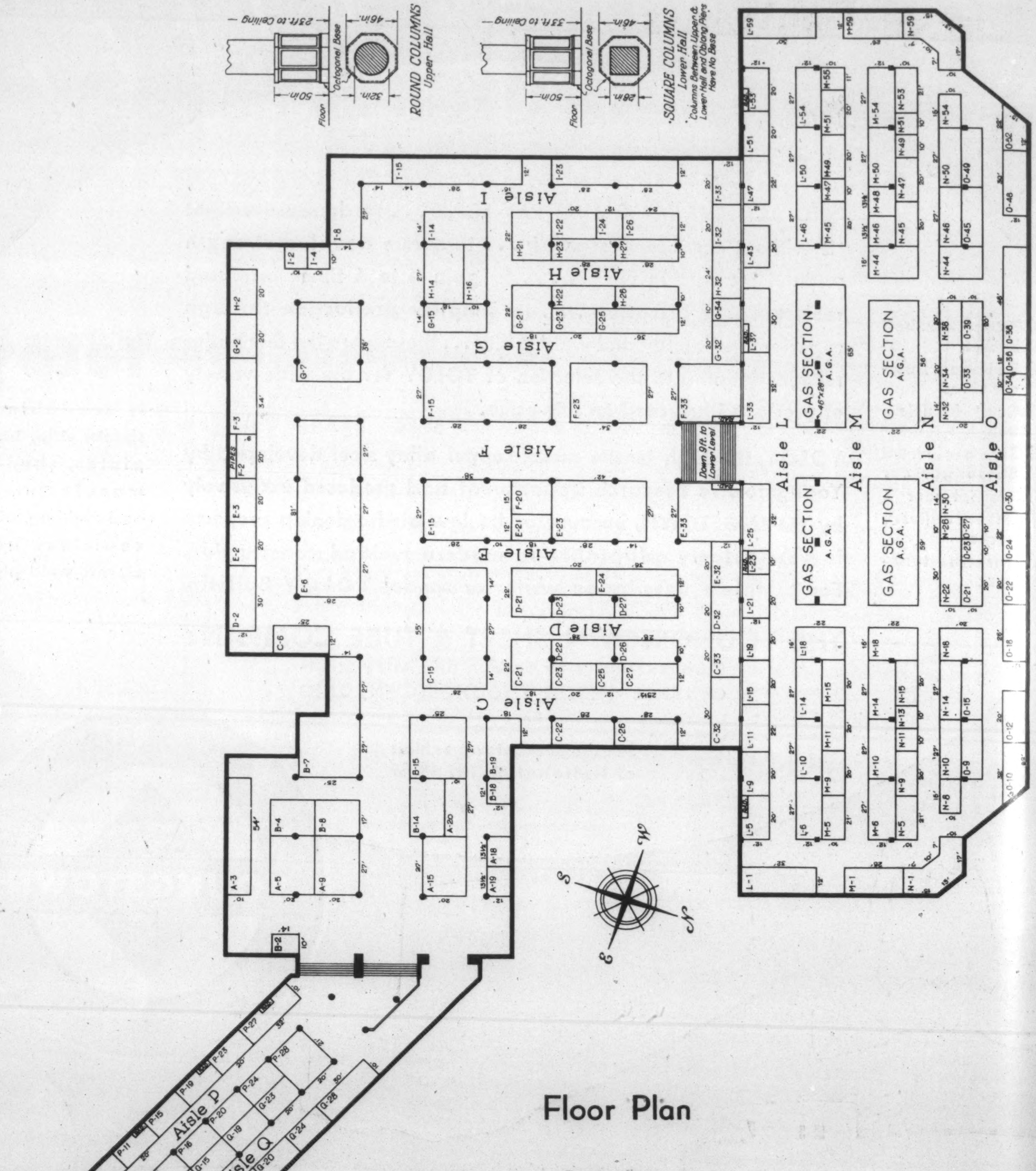

E

F
MANHATTAN COFFEE

G

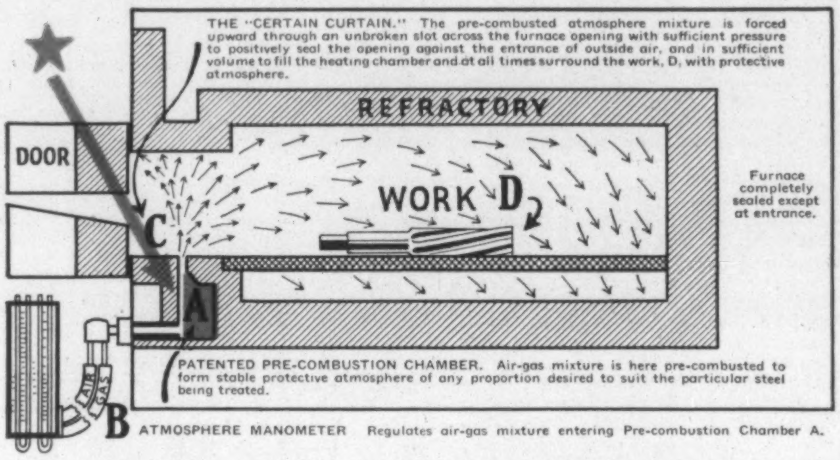

ROUND COLUMNS
Upper Hall
46in.
32in.
50in.
Octagonal Base
Floor
23ft. to Ceiling
SQUARE COLUMNS
Lower Hall
Columns Between Upper & Lower Hall and Oblong Piers Have No Base
46in.
28in.
50in.
Octagonal Base
Floor
33Ft. to Ceiling
Aisle C
Aisle D
Aisle E
Aisle F
Aisle G
Aisle H
Aisle I
Aisle L
Aisle M
Aisle N
Aisle O
Aisle P
Aisle Q
GAS SECTION
A.G.A.
46'x 28'
Down 9ft. to Lower Level
ONLY
ENTRANCE
AND
EXIT
N
S
E
W

Floor Plan
# of the
National Metal Exposition

List of Exhibitors

Acme Steel Co., Chicago.—Booth M-9.
Aetna Gases, Inc., Detroit.—Booth N-46.
Air Reduction Sales Co., New York.—Booth G-7.
Ajax Electric Co., Inc., Philadelphia.—Booth A-3.
Ajax Electrothermic Corp., Trenton, N. J.—Booth A-3.
Allegheny Steel Co., Brackenridge, Pa.—Booth C-22.
Edgar Allen Steel Co., Inc., Chicago.—Booth D-22.
Aluminum Co. of America, Pittsburgh.—Booth I-23.
American Brass Co., Waterbury, Conn.—Booth C-21.
American Bridge Co., Pittsburgh (United States Steel Corp. Subsidiary).—Booth C-15.
American Car & Foundry Co., New York.—Booth E-32.
American Cyanamid & Chemical Corp., New York.—Booth N-47.
American Electric Furnace Co., Boston.—Booth I-4.
American Foundry Equipment Co., Mishawaka, Ind.—Booth M-48.
American Gas Association, New York.—Industrial Gas Section.
American Gas Furnace Co., Elizabeth, N. J.—Booth, Gas Section.
American Institute of Mining and Metallurgical Engineers, New York. Booth P-19.
American Machine & Foundry Co., New York.—Booth M-47.
American Machine & Metals Mfg. Co., New York.—Booth B-19.
American Machinist and Product Engineering, New York.—Booth N 53.
American Metal Market, New York.—Booth L-47. (Left Half)
American Rolling Mill Co., Middletown, Ohio.—Booth L-59.
American Sheet & Tin Plate Co., Pittsburgh.—Booth C-15.
American Steel & Wire Co., Cleveland (United States Steel Corp. Subsidiary).—Booth C-15.
American Steel & Wire Co., Chicago.—Booth C-15.
Ampco Metal, Inc., Milwaukee.—Booth A-19.
Anderson & Sons, Springfield, Mass.—Booth N-51. (West Half).
Armstrong Blum Mfg. Co., Chicago.—Booth P-28.
Armstrong Cork Co., Lancaster, Pa.—Booth L-11.
Automatic Temperature Control Co., Inc., Philadelphia.—Booth L-9.
Automotive Industries, Philadelphia.—Booth O-10.
Babcock & Wilcox Co., Refractories Div., New York.—Booth N-18.
Baldwin-Southwark Corp., Philadelphia.—Booth P-15.
Bastian Blessing Co., Chicago.—Booth L-19.
Bausch & Lomb Optical Co., Rochester.—Booth D-23.
Bell & Gossett Co., Chicago.—Booth G-23.
Bethlehem Steel Co., Bethlehem, Pa.—Booth F-15.
G. S. Brakeslee & Co., Cicero, Ill.—Booth L-51
Bliss & Laughlin, Inc., Harvey. Ill.—Booth F-20.
Botfield Refractories Co., Philadelphia.—Booth N-49.
Bristol Co., Waterbury, Conn.—Booth L-15.
Brown Instrument Co. A Division of Minneapolis-Honeywell Regulator Co., Philadelphia.—Booth N-22.
Adolph I. Buehler, Chicago.—Booth N-10.
Bullard-Drum Process Division of The Bullard Co., Bridgeport, Conn.—Booth M-54.
Burdett Mfg. Co., Chicago.—Booth, Industrial Gas Section.
Calorizing Co., Pittsburgh.—Booth L18.
Carboloy Co., Inc., Detroit.—Booth A-20.
Carborundum Co., Niagara Falls, N. Y.—Booth 0-38.
Carnegie-Illinois Steel Co., Pittsburgh.—Booth C-15.
Carnegie-Illinois Steel Corp., Pittsburgh (United States Steel Corp. Subsidiary).—Booth C-15.
Case Hardening Service Co., Cleveland.—Booth G-23.
Chapman Valve Mfg. Co., Indian Orchard, Mass.—Booth 0-18.
Chemical Rubber Co., Cleveland.—Booth M-51.
Chilton Co., Philadelphia.—Booth 0-10.
Climax Molybdenum Co., New York.—Booth F-3.
Colmonoy Co., Los Nietos, Calif.—Booth N-46.
Columbia Steel Co., San Francisco (United States Steel Corp. Subsidiary).—Booth C-15.
Columbia Tool Steel Co., Chicago Heights, Ill.—Booth H-32.
Continental Industrial Engineers, Inc., Chicago.—Booth, Gas Section.
Continental Machine Specialties, Inc., Minneapolis, Minn.—Booth P-11.
Crown Rheostat & Supply Co., Chicago.—Booth L-46.
Cyclops Steel Co., Titusville, Pa.—Booth G-32.
Cyclone Fence Co., Waukegan, Ill. (United States Steel Corp. Subsidiary).—Booth C-15.
Dayton Rogers Mfg. Co., Minneapolis, Minn.—Booth E-3.
A. P. de Sanno & Son, Inc., Philadelphia.—Booth L-5.
Despatch Oven Co., Minneapolis, Minn.—Booth, American Gas Section.
Detroit Testing Machine Co., Detroit.—Booth N-54.
De Walt Products Corp., Lancaster, Pa.—Booth L-53.
Joseph Dixon Crucible Co., Jersey City, N. J.—Booth I-24.
Dow Chemical Co., Midland, Mich.—Booth C-27.
Driver-Harris Co., Harrison, N. J.—Booth G-21.
E. I. du Pont de Nemours & Co., Inc., R. & H. Chemicals Dept., Wilmington, Del.—Booth C-32.
Eclipse Fuel Engineering Co., Rockford, Ill.—Booth, Gas Section
Electric Furnace Co., Salem, Ohio.—Booth L-21.
Electro-Alloys Co., Elyria, Ohio.—Booth M-6.
Electro Metallurgical Co., New York.—Booth O-30.
Elevator Supplies Co., Inc., Hoboken, N. J.—Booth O-9.
Ensign-Reynolds, Inc., New York.—Booth, Gas Section.
Firth-Sterling Steel Co., McKeesport, Pa.—Booth D-32.
J. B. Ford Sales Co., Wyandotte, Mich.—Booth H-22.
Cyril A. Fox, Pittsburgh.—Booth ½ H-2.
Foxboro Co., Foxboro, Mass.—Booth L-1.
Fulton Foundry & Machine Co., Inc., Cleveland.—Booth O-33.
Gas Machinery Co., Cleveland.—Booth, Gas Section.
Gas Products Co., Cleveland.—Booth in 44.
Gathmann Engineering Co., Baltimore, Md.—Booth C-6.
General Alloys Co., Boston.—Booth P-8.
General Electric Co., Schenectady, N. Y.—Booth E-23.
General Electric X-Ray Corp., Chicago.—Booth E-21.
Globar Corp., Niagara Falls, N. Y.—Booth O-36.
Glogan Machine Co., Cleveland.—Booth N-9.
Claud S. Gordon Co., Chicago.—Booth B-18.
Grasselli Chemical Co., Inc., Cleveland.—Booth E-33.
Great Lakes Steel Corp., Ecorse, Detroit, Mich.—Booth P-16.
Grob Brothers, West Allis, Wisc.—Booth E-2.
Hamilton Steel Co., Cleveland.—Booth P-23.
Handy & Harman, New York.—Booth D-27.
Hardinge Brothers, Inc., Elmira, N. Y.—Booth L-14.
Harnischfeger Corp., Milwaukee.—Booth L-54.
Hauck Mfg. Co., Brooklyn, N. Y.—Booth N-5.
C. I. Hayes, Inc., Providence, R. I.—Booth G-15.
Haynes Stellite Co., Kokomo, Ind.—Booth O-30.
Heat Treating & Forging, Pittsburgh.—Booth N-13.
Hevi Duty Electric Co., Milwaukee.—Booth G-25.
Hobart Brothers, Troy, Ohio.—Booth B-15.
A. F. Holden Co., New Haven, Conn.—Booth M-18.
Hollup Corp., Chicago.—Booth M-15.
Charles A. Hones, Inc., Baldwin, N. Y.—Booth, Gas Section.
Hoskins Mfg. Co., Detroit.—Booth M-59.
E. F. Houghton & Co., Philadelphia.—Booth I-8.
Illinois Testing Laboratories, Inc., Chicago.—Booth N-26.
Industrial Publishing Co., Cleveland.—Booth P-24.
Ingersoll-Rand Co., Philipsburg, Pa.—Booth N-45.
International Nickel Co., Inc., New York.—Booth B-7.
Industrial Press, New York.—Booth O-21.
Iron Age, New York.—Booth O-48.
Iron & Steel Publishing Co., Pittsburgh.—Booth O-34.
C. O. Jelliff Mfg. Corp., Southport, Conn.—Booth N-11.
Johns-Manville Corp., New York.—Booth N-38.
Jones & Laughlin Steel Corp., Pittsburgh.—Booth E-15.
J. W. Kelley Co., Cleveland.—Booth H-16.
Kelley-Koett Mfg. Co., Inc., Chicago.—Booth A-18.
C. M. Kemp Mfg. Co., Baltimore.—Booth, Gas Section.
G. N. Krouse, New Kensington, Pa.—Booth Q-20.
La Salle Steel Co., Chicago.—Booth N-50.
Lakeside Steel Improvement Co., Cleveland.—Booth O-22.
Leeds & Northrup Co., Philadelphia.—Booth I-15.
E. Leitz, Inc., New York.—Booth H-14.
Lewis Machine Co., Cleveland.—Booth L-10.
Lincoln Electric Co., Cleveland.—Booth F-23.
Lindberg Engineering Co., Chicago.—Booth L-33.
Linde Air Products Co., New York.—Booth O-30.
Macklin Co., Jackson, Mich.—Booth C-26.
Magnaflux Corp., Chicago.—Booth N-15.
Magnetic Analysis Corp., Long Island City, N. Y.—Booth D-4.
Mahr Mfg. Co., Minneapolis, Minn.—Booth N-44.
P. R. Mallory & Co., Inc., Indianapolis.—Booth H-26.
Manhattan Rubber Mfg. Div., Passaic, N. J.—Booth H-2.
John A. Manning Paper Co., Inc., Troy, N. Y.—Booth M-1.
Marburg Brothers, Inc., New York.—Booth L-50.
Metal Industry, New York.—Booth N-59.
Metals & Alloys, New York.—Booth B-2.
Metal & Thermit Corp., New York.—Booth H-27.
Michiana Products Corp., Michigan, City, Ind.—Booth N-14.
Michigan Steel Casting Co., Detroit.—Booth I-14.
Midvale Co., Nicetown, Pa.—Booth B-14.
A. Milne & Co., New York.—Booth D-22.
Modern Machine Shop—Products Finishing (Magazines), Cincinnati.—Booth M-14.
Molybdenum Corp. of America, Pittsburgh.—Booth O-24.
Monarch Steel Corp., Indianapolis.—Booth M-55.
Morse Magneto Clock Co., New York.—Booth O-47.
Mullite Refractories Co., Shelton, Conn.—Booth O-15.
National Cylinder Gas Co., Chicago.—Booth M-44.
National Industrial Publishing Co., Pittsburgh.—Booth 0-27.
National Tube Co., Pittsburgh.—Booth C-15.
National Tube Co., Pittsburgh (United States Steel Corp. Subsidiary).—Booth C-15.
New Jersey Zinc Co., New York.—Booth D-21.
Nickel & Chromium Product Co., New York.—Booth L-23.
North American Mfg. Co., Cleveland.—Booth, Gas Section and M-45.
Norton Co., Worcester, Mass.—Booth Q-12 and Q-16.
Tinius Olsen Testing Machine Co., Philadelphia.—Booth B-8.
Ohio Crankshaft Co., Cleveland.—Booths A-5, A-9, and B-4.
Oster Mfg. Co., Cleveland.—Booth D-2.
Page Steel & Wire Division, Bridgeport, Conn.—Booth C-23.
Pangborn Corp., Hagerstown, Md.—Booth P-27.
Park Chemical Co., Detroit.—Booth M-11.
Parker-Kalon Corp., New York.—I-26.
Partlow Corp., New Hartford, N. Y.—Booth, Gas Section.
Henry Pels & Co., New York.—Booth Q-24.
Philadelphia Drying Machinery Co., Philadelphia.—Booth M-46.
Pittsburgh Instrument & Machine Co., Pittsburgh.—Booth G-34.
Product Engineering, New York.—Booth N-53.
Production Machine Co., Greenfield, Mass.—Booth Q-23.
Pyrometer Service & Supply Corp., Cleveland.—Booth B-18.
Quigley Co., Inc., New York.—Booth L-37.
Republic Steel Corp., Cleveland.—Booth E-6.
John A. Roebling's Sons Co., Trenton, N. J.—Booth O-12.
Rustless Iron & Steel Corp., Baltimore.—Booth L-43.
Joseph T. Ryerson & Son, Inc., Chicago.—Booth I-22.
Safety Gas Lighter Co., Lynn, Mass —Booth I-33.
Salem Engineering Co., Salem, Ohio.—Booth M-10.
George Scherr Co., Inc., New York.—Booth D-26.
Scully Steel Products Co., Chicago (United States Steel Corp. Subsidiary).—Booth C-15.
Selas Co., Philadelphia, Pa.—Booth, Gas Section.
Sentry Co., Foxboro, Mass.—Booth O-25.
Spencer Turbine Co., Hartford, Conn.—Booth N-34.
Steel, Cleveland.—Booth Q-4.
Steel City Testing Laboratory, Detroit.—Booth M-5.
Stoody Co., Whittier, Calif.—Booth N-8.
D. A. Stuart Oil Co., Chicago.—Booth L-25.
Surface Combustion Corp., Toledo.—Booth, Gas Section.
Syncro Machine Co., Newark, N. J.—Booth N-1.
C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.—Booth M-15.
Tennessee Coal, Iron and Railroad Co., Birmingham, Ala. (United States Steel Corp., Subsidiary).—Booth C-15.
Timken Steel & Tube Co., Canton, Ohio.—Booth F-33.
Titanium Alloy Mfg. Co., Niagara Falls, N. Y.—Booth M-50.
Una Welding, Inc., Cleveland.—Booth H-23.
Union Carbide & Carbon Co., New York.—Booth O-30.
United States Steel Corp., Subsidiaries, Pittsburgh.—Booth C-15.
Universal Steel Co., Bridgeville, Pa.—Booth G-32.
Vanadium-Alloys Steel Co., Latrobe, Pa.—Booth Q-28.
Vanadium Corp. of America, New York.—Booth G-2.
Victor Saw Works, Inc., Middletown, N. Y.—Booth F-2.
Weldit Acetylene, Detroit.—Booth M-16.
Welding Engineer Publishing Co., Chicago.—Booth M-49.
Wells Mfg. Corp., Three Rivers, Mich.—Booth I-2.
Wheelco Instruments Co., Chicago.—Booth I-32.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.—Booth H-21.
Williams & Co., Inc., Cleveland.—Booth O-39.
Wilson Mechanical Instrument Co., Inc., New York.—Booth C-25.
Wilson Welder & Metals, Inc., North Bergen, N. J.—Booth G-7.
Wire Association, New York.—Booth N-3.
Youngstown Sheet & Tube Co., Youngstown, Ohio.—Booth E-24.
Carl Zeiss, Inc., New York.—Booth C-33.

You can *eliminate* hardening spoilage thru *PRE-COMBUSTION of atmosphere!



THE "CERTAIN CURTAIN." The pre-combusted atmosphere mixture is forced upward through an unbroken slot across the furnace opening with sufficient pressure to positively seal the opening against the entrance of outside air, and in sufficient volume to fill the heating chamber and at all times surround the work, D, with protective atmosphere.

Furnace completely sealed except at entrance.

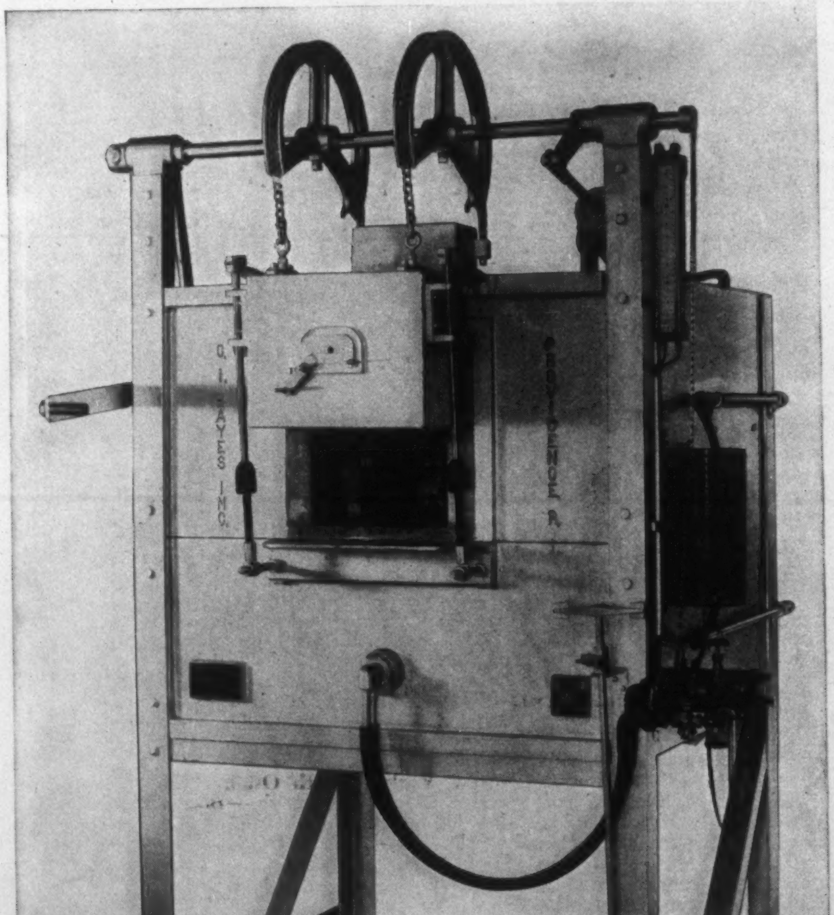
PATENTED PRE-COMBUSTION CHAMBER. Air-gas mixture is here pre-combusted to form stable protective atmosphere of any proportion desired to suit the particular steel being treated.

B ATMOSPHERE MANOMETER Regulates air-gas mixture entering Pre-combustion Chamber A.

PATENTED IN THE U. S. A. AND FOREIGN COUNTRIES

PRECOMBUSTION of furnace atmosphere is a distinctive patented feature of "Certain Curtain" electric furnaces.

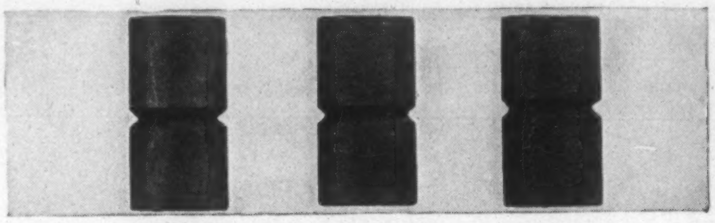
Before it can come into contact with the steel, the atmosphere in a Hayes furnace is completely under the control of the hardener. He can eliminate 90% of the usual spoilage and can turn out more tools of higher average working life.



Leading tool firms state that their "Certain Curtain" furnaces are an intensely practical form of Spoilage Insurance. They state that the equipment pays for itself very rapidly, sometimes in less than a year. And they adduce facts and figures to prove it!

If incomplete control of furnace atmosphere is causing you spoilage, forcing your hardener to quench tools short of their maximum hardness, preventing him from achieving swift, accurate, uniform production—such a situation can be remedied, AT A PROFIT rather than an expense, by giving him Precombustion Control.

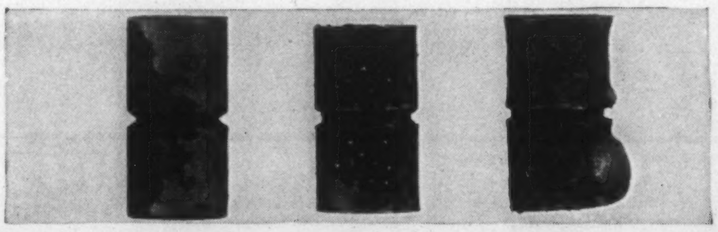
Upon request full data will be mailed.



A

CERTAIN CURTAIN
Pre-Combustion Control

Above are three of six pieces of high speed steel, one held normal, one twice normal, and one three times normal in "Certain Curtain" Precombustion control furnace atmosphere. Note there is no attack on the surface.



B

OTHER FURNACE
Burning Gas Control

Here are the other three pieces, one held normal, one twice normal and one three times normal in a different make of furnace in which the "atmosphere control" readings were exactly the same as the "Certain Curtain" furnace above. Note destruction of the surface on the two held overtime.

SPECIAL NOTE. See these furnaces in operation at the Show with the new recording equipment for continuous graphic record of furnace atmosphere.

C. I. HAYES, INC.

129 Baker St., Providence, R. I. Est. 1905

ELECTRIC CERTAIN REGISTERED U. S. PAT. OFFICE CURTAIN FURNACES

Still too Heavy!

SUBSTITUTE PAYLOAD FOR DEADLOAD WITH DOWMETAL

To demonstrate what Dowmetal does in reducing weight this passenger bus was produced. The entire body, seat frames, window frames, and doors were fabricated of various Dowmetal alloys. The total weight gained over conventional steel construction was close to one ton!

Engineers in all branches of industry are paying more and more attention to achieving greater structural lightness.

Taking their cue from the notable advancements in aviation—the rising ratio of performance to power—they are bringing to a multitude of products the greater lightness of Dowmetal.

Dowmetal is a full third lighter than aluminum, yet offers, in its various alloys, satisfactory degrees of strength and durability.

Dowmetal is available in sand and die castings, forgings, sheet, plate, standard and special extruded shapes. A complete foundry and mill at Midland is prepared to give prompt service. In addition, there are recommended sources in various parts of the country where partial or finished fabrication of Dowmetal is offered.

The uses of Dowmetal are constantly widening. Typical instances include foundry flasks, blower fans, portable power tools, typewriter parts, and a host of other instances where less weight is of definite value.

Every metal user, production head, engineer and designer should be familiar with the properties, uses and methods of fabricating Dowmetal. The Dowmetal Data Book covers the subject fully and will be promptly sent without obligation. Write today for your copy.

DOWMETAL

MAGNESIUM ALLOYS

LIGHTEST OF ALL STRUCTURAL METALS

Dowmetal on Display—Booth C-27, The National Metals Exposition, Cleveland, Ohio, October 19-23.

THE DOW CHEMICAL COMPANY · *Dowmetal Division* · Midland, Michigan

Exhibitors and What They Will Present

Eighteenth National Metal Exposition, Cleveland, 1936

Acme Steel Co., Chicago—Booth M-9.

Exhibiting (in operation): Colored cold rolled strip steel in a variety of color. The Acme colorstrip can be bent, drawn, and formed. A prize contest will be open to visitors at the booth.

Aetna Gasses, Inc., Detroit—Booth N-46.

Air Reduction Sales Co., New York—Booth G-7.

Ajaz Electric Co., Inc., Philadelphia——Booth A-3.

Exhibiting: Salt bath furnace, Ajax-Hultgren furnace for cyaniding, hardening, annealing and tempering. Display of photographs showing various types of Ajax Electric heat-treating furnaces.

Ajax Electrothermic Corp., Trenton, N. J.—Booth A-3.

Exhibiting: Zone hardening with high frequency currents in co-operation with the Ohio Crankshaft Co. A production size high frequency melting furnace and a number of enlarged pictures of high frequency furnace installations and products.

Allegheny Steel Co., Brackenridge, Pa.—Booth C-22.

Exhibiting: Many applications of "Allegheny Metal" and other grades of Allegheny time tested stainless steels. A number of new fabricated items which have been marketed during the past year and various samples of commercial forms such as sheets, bars, plates, strip, tubing, wire, rivets, etc.

Edgar Allen Steel Co., Inc.—Booth D-22.

See A. Milne & Co.

Aluminum Co. of America, Pittsburgh—Booth I-23.

Exhibiting: Newest developments in aluminum alloys and their applications.

American Brass Co., Waterbury, Conn.—Booth C-21.

American Bridge Co., Pittsburgh (United States Steel Corp. Subsidiaries)—Booth C-15.

Exhibiting: See "United States Steel Corp. Subsidiaries."

American Car & Foundry Co., New York—Booth E-32.

Exhibiting (in operation): Six-foot bar heater—this heater will have water-cooled electrode, electric eye for controlling temperature and air cylinder for opening and closing electrode. Will heat any diameter stock from ½ to 1 in. Fully-automatic heater; type "L" forging heater; horizontal "C" heater; and No. 2 two-electrode rivet heater.

American Cyanamid & Chemical Corp., New York—Booth N-47.

Exhibiting: Aerocase case hardening compounds; sodium cyanide; cyanide case hardening compounds; electroplating chemicals; and chemicals to the ferrous and non ferrous industries.

American Electric Furnace Co., Boston—Booth I-4.

Exhibiting: A complete photographic display of standard Juthe gas and "American" electric furnaces, including installations.

American Foundry Equipment Co., Mishawaka, Ind.—Booth M-48.

Exhibiting (in operation): An operating display of the Wheelabrator mechanism in a glass cage, which is an airless abrasive method of cleaning castings, descaling forgings or other metal products in preparation for final finishes, such as stove castings, automobile gears, drop forgings, metal stampings and similar products.

American Gas Association, New York—Industrial Gas Section.

American Gas Furnace Co., Elizabeth, N. J.—Booth, Gas Section.

Exhibiting (in operation): A small rotary carburizing machine, a vertical bell type retort furnace for carburizing, nitriding, clean annealing, "Ni-Carb-Casing." Also a small demonstrating full muffle reciprocating heating machine for hardening in a controlled atmosphere with freedom from scaling or decarburization, also for annealing. Other items exhibited will be a high heat melter, an improved pot hardening furnace, improved oven and tool room furnaces, burners, blowpipes, flow meters, heat controllers, etc. A new oven furnace, top and bottom fired from both sides and bottom vented. There is no vent or opening of any kind in the top of the heating chamber; consequently, products of combustion must exit through the bottom or through the door when it is opened. In this way, chimney action is eliminated, and cold air cannot be drawn into the furnace when the door is opened. Most of the heat is supplied by the top burners, the bottom burners being supplementary and furnishing the heat necessary to maintain uniformity throughout the chamber. Supplementary neutralizing atmosphere burners are provided which make it possible to adjust the heating burners for most efficient combustion and then set the neutralizing burners to combust any small percentage of excess air remaining in the products of combustion, thereby making it possible to turn out work with a minimum of scale and free from decarburized surfaces. This furnace is supplied both for the regular hardening and carburizing heats and also for the hardening of high speed steel.

American Institute of Mining and Metallurgical Engineers, New York—Booth P-19.

American Machine & Foundry Co., New York—Booth M-47.

American Machine & Metals Mfg. Co., New York—Booth B-19.

American Machinist and Product Engineering, New York —Booth N-53.

Exhibiting: An educational exhibit, featuring the service of *American Machinist* and *Product Engineering* to the metal-working industry.

American Metal Market, New York—Booth L-47 (left half).

Exhibiting: The pioneer daily newspaper of the iron, steel and metal working industries. Established in 1882 as a weekly. Published daily since 1899. Publishing daily market reports, prices, and news developments affecting the iron, steel and metal fields.

American Rolling Mill Co., Middletown, Ohio—Booth L-59.

Exhibiting: Applications of "Armco" stainless steels and Armco enameling iron. The entire background of the booth is made of various grades of Armco metals, illustrating several types of stainless steel finishes. What are believed to be two of the most intricate stainless steel etchings ever produced are part of the colorful background. Parts of the etchings are colored with special oil preparations.

For both the etchings and part of the background, Armco No. 6 soft finish stainless steel was used. Edges of the exhibit which are also etched, are of bright Armco 18-8 mirror-finish stainless steel. The fabricated letters also are of 18-8 stainless.

Models of many commercial products showing the application of Armco's special grades of sheets and plates will be exhibited. They will demonstrate the drawing and welding properties of many kinds of Armco metals. Besides stainless steel and enameling iron, there will be miniatures of products in which "Armco H. T. 50," electrical, and hot and cold rolled sheets are used.

American Sheet & Tin Plate Co., Pittsburgh—Booth C-15.

American Steel & Wire Co., Cleveland (United States Steel Corp. Subsidiaries)—Booth C-15.

Exhibiting: See "United States Steel Corp. Subsidiaries."

American Steel & Wire Co., Chicago—Booth C-15.

Ampco Metal, Inc., Milwaukee—Booth A-19.

Exhibiting: The various grades of Ampco and Atlas

(Continued on page P 28)

MICHIANA
Heat-Resistant and
Stainless Steel
ALLOY CASTINGS

Michiana Rewarded for "Fussiness"

Heat-Resistant and Stainless Steel Alloy Castings must meet conditions too severe for ordinary materials. Their successful production requires the closest attention to the smallest details—"fussiness."

Michiana has specialized for 18 years in Heat-Resistant and Stainless Steel Alloy Castings. And all members of the Michiana organization are selected for their "fussiness" over details and are trained to establish these habits more firmly.

Remarkable growth has rewarded Michiana for this policy — particularly among companies who are themselves "fussy" over the quality of their products and who, for that reason, stand high in their respective fields.

MICHIANA
STAINLESS STEEL
HEAT-RESISTANT
ALLOY CASTINGS

New book illustrates and describes many savings with Michiana Castings Write for a copy.

VISIT BOOTH N-14, NATIONAL METAL EXPOSITION—CLEVELAND

MICHIANA PRODUCTS CORP., Michigan City, Ind.

L. H. WHITESIDE and
LLOYD J. BOHAN
80 E. Jackson Blvd., Chicago, Ill.

PAUL S. MENOUGH
Chamber of Commerce Bldg.
Pittsburgh, Pa.

E. E. WHITESIDE
1219 St. Clair Ave.
Cleveland, Ohio

HARRY C. ARMIN
754 East 23rd St.
Brooklyn, N. Y.

C. Q. SWENSON
2842 West Grand Blvd.
Detroit, Mich.

C. M. CONNER
1701 Arch Street
Philadelphia, Pa.

T. G. FRAZEE
Petroleum Bldg.
Houston, Texas

JOHN R. GEARHART
600 Fallon St.
Oakland, Calif.

W. C. SCHADE, Jr.
Rm. 472, Paul Brown Bldg.
St. Louis, Mo.

(Continued from page P 26)

metals and test specimens indicating high physical properties and compressive resistance. Typical parts showing the application of these metals in machine tools, steel mill equipment, pickling parts, forming dies, and safety tools.

Anderson & Sons, Springfield, Mass.——Booth N-51 (West Half).
Exhibiting: Etched and lithographed metal products, such as nameplates, signs, dials and novelties.

Armstrong Blum Mfg. Co., Chicago——Booth P-28.

Armstrong Cork Co., Lancaster, Pa.—Booth L-11.

Automatic Temperature Control Co., Inc., Philadelphia—Booth L-9.
Exhibiting (in operation): Relatrol control system, the Atc balancer, various two and three-position control mechanisms, current input controllers for electric furnaces with both manual and automatic adjustment; and dial, cam and reset timers.

Control valves for air, gas, water, oil and steam.

Automotive Industries, Philadelphia—Booth O-10.

Babcock & Wilcox Co., Refractories Div., New York—Booth N-18.
Exhibiting: An animated display showing the unusual savings effected through the use of Babcock & Wilcox insulating firebrick, but featuring the characteristics of light weight, low thermal conductivity, and high temperature strength. Reports giving the amount of savings in actual installations will be available as well as information on special forms of constructions.

Baldwin-Southwark Corp., Philadelphia—Booth P-15.
Exhibiting (in operation): Southwark-Emery universal testing machine equipped with the new Tate-Emery multi-range load indicating dial, first time publicly shown. High speed R. R. Moore rotating beam fatigue testing machine using standard size specimen.

Bartlett-Hayward Co., Baltimore—Booth N-2.

Bastian Blessing Co., Chicago—Booth L-19.
Exhibiting (in operation): Oxy-acetylene welding and cutting equipment, torches, regulators, manifolds, etc. Liquefied petroleum regulators, manifolds and special valves. Continuous demonstration of an efficient gas cutting operation in which the observers may estimate the quantity of oxygen consumed each day. A daily prize is offered for the closest estimate. Additional demonstrations of hand welding and cutting operations.

Bausch & Lomb Optical Co., Rochester——Booth D-23.
Exhibiting (in operation): Complete line of optical instruments for metallography and spectrography. Wide field binocular microscope and the new metallographic equipment of advanced type for research. A full line of cameras, metallographic microscopes, Brinell mscroscopes, etc.

Bell & Gossett Co., Chicago—Booth G-23.

Bethlehem Steel Co., Bethlehem, Pa.—Booth F-15.
Exhibiting (in operation): Moving panorama of 4 ft. by 8 ft. murals showing production of strip-sheet. A working model of one of the modern-type annealing furnaces. Two complete 45-min. talking pictures showing the making of alloy steel and of wire. Exhibits of finished products of various applications of "Bethanized" wire, "Silvery Mayari" castings, sheets of representative finishes, products made of deep-drawing quality strip-sheet, example of alloy bolting materials and applications of "Bethalon' and "Bethadur" (corrosion resisting steels.)

G. S. Blakeslee & Co., Cicero, Ill.—Booth L-51.
Exhibiting (in operation): A spiral type oil quenching and washing machine for handling automatic parts that have been heat treated, quenched in oil, and want to be cleaned. Also the Blakeslee line of degreasing machines using Blacosolv, a chlorinated solvent, to remove the oil and grease from work prior to plating, painting assembling, or inspection. The metal parts are rendered chemically clean and dry without any streaks, spots, runs, stains, or marks.

Bliss & Laughlin, Inc., Harvey, Ill.—Booth F-20.
Exhibiting: A motion picture showing the various operations necessary in the production of quality cold finished bar steels. A display of fabricated parts as cut from such bar steel. Expert automatic screw machine engineers will be on hand to discuss the various fabricating and machining operations that may be a part of your problems and offer suggestions that will be helpful.

Botfield Refractories Co., Philadelphia—Booth N-49.

Bristol Co., Waterbury, Conn.—Booth L-15.
Exhibiting (in operation): Bristol's wide-strip recording potentiometer; the metameter telemetering system; the pyromaster, and the pyrotrol. These are all new developments which we believe will create considerable interest, since they will actually be operating under conditions similar to normal operation.

The wide-strip potentiometer is built along the lines of the conventional strip type pyrometer, except that it has a considerable number of refinements; including extra sensitive galvanometer, 12¼ inch chart, only seven moving parts and modernistic lines.

The round chart pyromaster is an entirely new and distinct type of pyrometer which is put into a case smaller than any on the market today. Its outstanding feature is "stability." This instrument can be banged around and handled roughly and still operate satisfactorily. Due to the ingenious method of using a sensitive galvanometer together with other patented ideas never before used in pyrometer circuits, this instrument will be one of the most outstanding pyrometers on the market today.

The metameter telemetering outfit is unique in that only two wires are used between the transmitting and receiving instruments. This eliminates all errors due to induced circuits, resistances and other line disturbances which so frequently give trouble on the 3-wire balanced type systems. This instrument can be operated over private wires and also on telephone lines and if required, may be used over telephone lines already carrying voice transmission.

Brown Instrument Co. A Division of Minneapolis-Honeywell Regulator Co., Philadelphia—Booth N-22.
Exhibiting (in operation): Indicating, recording and automatic control instruments used in the production, fabrication and heat treatment of both ferrous and nonferrous metals. Automatic control systems for different type of furnaces and different heating mediums including new designs of industrial motor valves and air-operated control equipment. The optimatic pyrometer for recording rapidly changing temperatures or the temperature of moving objects. Potentiometer pyrometers, flow meters, thermometers, millivoltmeter pyrometers, pressure gauges, CO₂ meters, radiation pyrometers, furnace atmosphere recorders and combustion safeguard equipment.

Adolph I. Buehler, Chicago.—Booth N-10.
Exhibiting (in operation): A-B specimen cutting machines; A-B bakelite presses; A-B specimen grinders; A-B specimen polishers; A-B specimen holders; also latest metallographic microscopes of Bausch & Lomb, Leitz and Carl Zeiss, manufacture.

Bullard-Dunn Process Division of The Bullard Co., Bridgeport, Conn.—Booth M-54.
Exhibiting (in operation): The Bullard-Dunn electrochemical process for descaling metals. A demonstration unit comprising small glass tanks which permit the observation of the cleaning action with the simultaneous deposition of a protective metal coating. A moving picture demonstration of the Bullard-Dunn continuous rotary immersion machine as applied to an actual commercial installation of the process and display of a variety of work samples.

Burdett Mfg. Co., Chicago.—Booth-Industrial Gas Section.
Exhibiting (in operation): Burdett radiant heat gas burners (radiant refractory discs). Gas burning equipment for: white metal melting, metal annealing, industrial ovens, forging furnaces, glass melting, glass annealing, varnish cooking, etc.

Calorizing Co., Pittsburgh—Booth L-18.
Exhibiting: We shall exhibit centrifugally cast tubes, a new type of annealing box, furnace rollers, chains, etc.

Carboloy Co., Inc., Detroit.—Booth A-20.

(Continued on page P 30)

COORDINATION

● Yo-heave-ho! Perfect coordination of all hands on deck, the mainsail goes up, and we're off in a spanking breeze! . . . In steel making, it's the coordination of metallurgical factors during the melting of a heat that gives the steel a perfect start. Important among these metallurgical factors are the right ferro-alloys and their addition to the heat in correct amounts under the most suitable operating conditions.

Since 1906 Electromet has made the *right* ferro-alloys. Electromet Metallurgists, with years of practical experience in steelmaking, can help you use them properly to make better steel. This assistance is part of Electromet Service which is available without obligation.

ELECTRO METALLURGICAL COMPANY
Unit of Union Carbide and Carbon Corporation
UCC
Carbide and Carbon Bldg., 30 E. 42nd St., New York, N. Y.

Electromet
Ferro-Alloys & Metals

(Continued from page P 28)

Carborundum Co., Niagara Falls, N. Y.—Booth O-38.
Exhibiting: A complete exhibit of its principal abrasive and refractory products used in the metal working industries. The most recent models of "Carborundum-Hutto" honing heads and other special devices. An interesting display of Globar non-metallic heating elements with definite examples of their application to industrial furnaces.

Carnegie-Illinois Steel Co., Pittsburgh—Booth C-15.

Carnegie-Illinois Steel Corp., Pittsburgh, (United States Steel Corp. Subsidiaries)—Booth C-15.
Exhibiting: See "United States Steel Corp. Subsidiaries."

Case Hardening Service Co., Cleveland.—Booth G-23.
Exhibiting: Carburizing compounds, heat treating salts, carburizing boxes and pots, non-case anti-carburizing paint, cleancoat lead pot covering.

Chapman Valve Mfg. Co., Indian Orchard, Mass.—Booth O-18.
Exhibiting: Chapmanizing equipment and complete technical information regarding operation of the process Samples showing actual application of Chapmanizing to steel parts. Also a sample line of steel valves.

Chemical Rubber Co., Cleveland.—Booth M-51.

Chilton Co., Philadelphia.—Booth O-10.
Exhibiting: Magazines.

Climax Molybdenum Co., New York.—Booth F-3.
Exhibiting: A series of panels exemplifying the application of molybdenum steels and irons.

Colmonoy Co., Los Nietos, Calif.—Booth N-46.

Columbia Steel Co., San Francisco. (United States Steel Corp. Subsidiary).—Booth C-15.
Exhibiting: See "United States Steel Corporation Subsidiaries."

Columbia Tool Steel Co., Chicago Heights, Ill.—Booth H-32
Exhibiting (in operation): Tools and specimens of "clarite" high speed, "Vanite" high speed, "Maxite" super high speed, "Superdie" high carbon-high chromium, "Oildie" non-strinking, "Exl-die" oil hardening, "Buster" punch and chisel, special, extra vanadium, extra and standard tool steel.

Continental Industrial Engineers, Inc., Chicago.—Booth, Gas Section.
Exhibiting (in operation): A working model of the Continental patented forced convection heat treating system. This will be made to scale and provided with a glass in one wall so that it will be possible to notice the effect of the circulating air currents.

Another important exhibit will be a fully automatic heat treating unit which will mechanically transfer the articles being heat treated from a preheat position into a salt bath, from the salt bath into the quench bath and then through subsequent operations, returning the articles back to the loading position. This equipment will be complete with electric motor and will be constructed on a small scale, but comparable with a standard unit. The equipment will be in continuous operation, showing the actual mechanical movements involved.

Continental Machine Specialties, Inc., Minneapolis, Minn. —Booth P-11.
Exhibiting (in operation): 5 models of the "Continental Doall" combination machine for continuous filing and continuous narrow blade precision sawing. One shelf with reflecting mirror to exhibit a large number of specimens of unusual jobs done with these machines.

Crown Rheostat & Supply Co., Chicago—Booth L-46.
Exhibiting (in operation): Plating barrels, polishing lathes, centrifugal dryers, rheostats, chromium anodes, and buffing wheels.

Cyclops Steel Co., Titusville, Pa.—Booth G-32.
Exhibiting: See Universal Steel Co.

Cyclone Fence Co., Waukegan, Ill. (United States Steel Corp.)—Booth C-15.
Exhibiting: See "United States Steel Corp. Subsidiaries."

Dayton Rogers Mfg Co., Minneapolis, Minn.—Booth E-3.
Exhibiting: Representative group of metal stampings made under our special die stamping process.

A. P. de Sanno & Son, Inc., Philadelphia—Booth L-5.
Exhibiting (in operation): Type "G" Radiac cut-off machine; type "J" Radiac cut-off machine; type "F" Radiac cut-off machine. These use abrasive cut-off discs for the cutting of metals, fibrous materials, etc. Abrasive cut-off discs. Two display cases of grinding wheels.

Despatch Oven Co., Minneapolis, Minn.—Booth, American Gas Section.
Exhibiting (in operation): A new Despatch dense load convected air furnace, gas fired, designed for maximum temperatire of 1200 deg. F. and is recommended for drawing and tempering work. This new line of furnaces will be marketed at a radically low price.

Detroit Testing Machine Co., Detroit—Booth N-54.
Exhibiting: A complete line of physical testing apparatus including: Direct reading Brinell machine, universal testing machine, ductility testers, etc.

DeWalt Products Corp., Lancaster, Pa.—Booth L-53.
Exhibiting (in operation): A semi-automatic metal cutting machine, cutting light wall metal tubing to specified lengths, making 20 to 28 cuts per min. After the material is placed on the feed table it is automatically pushed against the stop, clamped by automatic vises and simultaneously cut off. The feed jaws grasp the incoming material again, pushing it against the stop and displacing the material cut off. Thus the operation is repeated. Also a metal cutting machine, cutting ferrous and non-ferrous metal with saw blades and abrasive wheels, cutting wet and dry.

Joseph Dixon Crucible Co., Jersey City, N. J.—Booth I-24
Exhibiting: The latest developments in Dixon stoppers, nozzles and sleeves, particularly for use in melting of alloy steels in electric furnaces, and special steels in steel casting shops.

Dow Chemical Co., Midland, Mich.—Booth C-27.
Exhibiting: Various sand and die castings, forgings, rolled sheet, and plate, and extruded sections of "Dowmetal" magnesium alloys.

Driver-Harris Co., Harrison, N. J.—Booth G-21.
Exhibiting: Heat and corrosion resisting alloys such as "Nichrome," "Chromax," "Cimet"; in the form of castings, bars, strip, carburizing containers, sheet containers, enameling racks, normalizing shafts, dipping baskets, lead pots, and diamond dies.

E. I. du Pont de Nemours & Co., Inc., R. & H. Chemicals Dept., Wilmington, Del.—Booth C-32.
Exhibiting (in operation): Demonstration of barrel-plating of steel parts, display of case-hardened and heat-treated steel articles.

Eclipse Fuel Engineering Co., Rockford, Ill.—Booth, Gas Section.
Exhibiting (in operation): Heat-treating furnaces, recirculating heaters, industrial gas burners including tunnel type, pipe type and other miscellaneous types. Gas injectors, safety gas valves, proportional mixers, temperature control valves, pressure blowers, pressed steel pots metal melting furnaces, dowtherm boiler.

Electric Furnace Co., Salem, O—Booth L-21.
Exhibiting: Enlarged photographs of new developments in controlled atmosphere furnaces for brazing, scale-free heat treating and bright annealing ferrous and non-ferrous metals, including wire, sheet, tubing, strip, stampings, etc. Also, samples of material treated in these furnaces. Photographs of furnaces for normalizing, carburizing, nitriding, forging, annealing and other heat treating processes. Elfurno gas generator for producing the special protective atmosphere needed in bright annealing, scale-free heat treating and copper brazing furnaces.

Electro-Alloys Co., Elyria, O.—Booth M-6.
Exhibiting (in operation): "Thermalloy" heat-treating equipment and application of X-ray inspection.

(Continued on page P 34)

...that anticipates the needs of an ever-changing world . . . *in terms of better steels*

WHAT a responsibility rests on the makers of Steel today! Greater strength . . . more lasting beauty . . . lighter weight . . . and, always, lower cost. All must be incorporated in modern Steels—in a hundred variations and combinations.

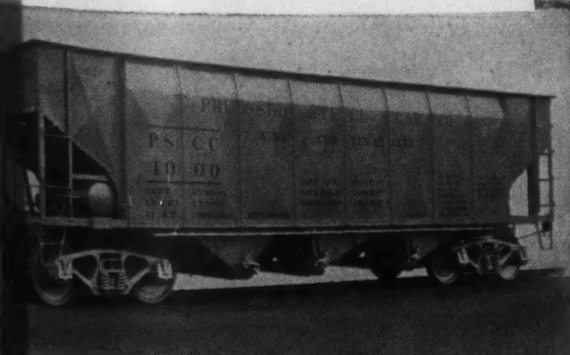
How strongly we feel our responsibility, how willingly we accept it, is perhaps best mirrored in the facilities for research that we have so painstakingly built up over a period of years. Day after day more than 1700 technical experts (metallurgists, scientists, researchers) working in our 81 laboratories, continue their never-ceasing search for better Steels to make Industry's job easier, more profitable—to bring new beauty and new conveniences in a thousand different forms into the lives and homes of millions of people.

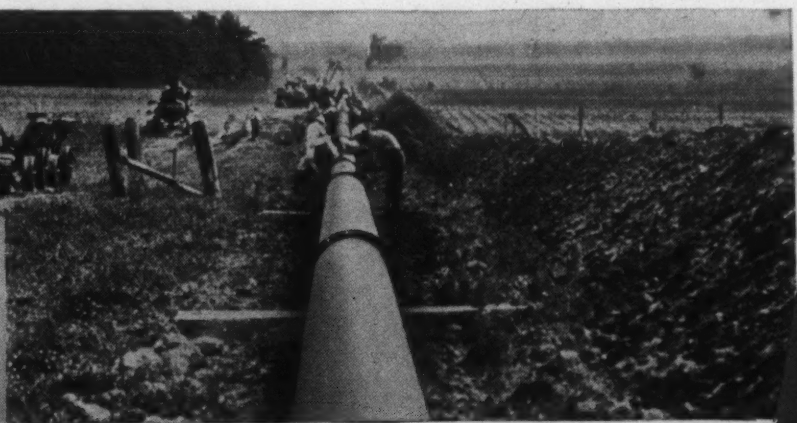
From these endeavors have come Cor-Ten, Man-Ten and other USS High Tensile Steels, making possible greater strength at ever-decreasing weight. USS Stainless Steels have recorded significant successes throughout Industry. In factories, plants, and machine shops—in trains, street-cars, automobiles and busses—in stores and office buildings, in homes of all descriptions, ours has been a major contribution to progress.

Look at the examples pictured on these pages. See in these illustrations how we have made Steels to match the varied needs of Industries. Each in itself is a tribute to this forward-looking research. Each in itself is proof positive that we, too, like Industry, are never satisfied—even with the best.

AMERICAN BRIDGE COMPANY: *Pittsburgh* . . . AMERICAN STEEL & WIRE COMPANY: *Chicago and New York* . . . CARNEGIE-ILLINOIS STEEL CORPORATION: *Pittsburgh and Chicago* . . . COLUMBIA STEEL COMPANY: *San Francisco* . . . NATIONAL TUBE COMPANY: *Pittsburgh* . . . SCULLY STEEL PRODUCTS COMPANY: *Chicago* . . . TENNESSEE COAL, IRON & RAILROAD COMPANY: *Birmingham* . . . UNITED STATES STEEL PRODUCTS COMPANY: *New York, Export Distributors.*

What USS COR-TEN, Stainless and other USS High Tensile Steels can do to reduce dead weight, lower operating costs, increase traffic is well demonstrated in the schedule-smashing streamliners. And in freight equipment, hopper cars built 20% lighter with USS COR-TEN haul 20% more pay-load than before, show savings in operation that make the investment practically self-liquidating.





Detroit has enjoyed the advantages of less expensive natural gas for several weeks now—brought through a 22" Seamless Pipe line from Zionsville, 230 miles away National Tube Company foresaw the demand for these huge pipe lines to carry gas, oil and gasoline and knew the superiority of Seamless Pipe for this work. They installed the largest machinery in the world for the manufacture of large diameter Seamless Pipe to handle this demand.

See our Exhib
BOOTH C-1
NATIONAL METAL SHOW
CLEVELAND

UNITED STATES STEEL

FULLY AUTOMATIC HEAT TREATING

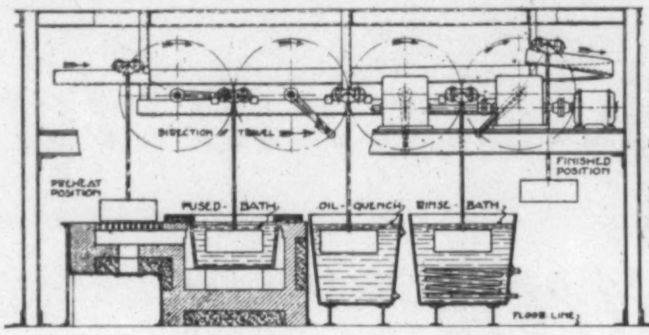


Diagram at left shows a Typical Unit for Fully Automatic Heat Treating

ADVANTAGES

Uniformity is Mechanically Maintained
Quality is Constant
Transfer Time is Short and Controlled
Operating Cost is Low
Cycle and Size Suited to All Jobs
Warping Largely Reduced
Inspection is Unnecessary
Skilled Labor is Eliminated
Loading and Unloading is Sole Labor

We Recommend

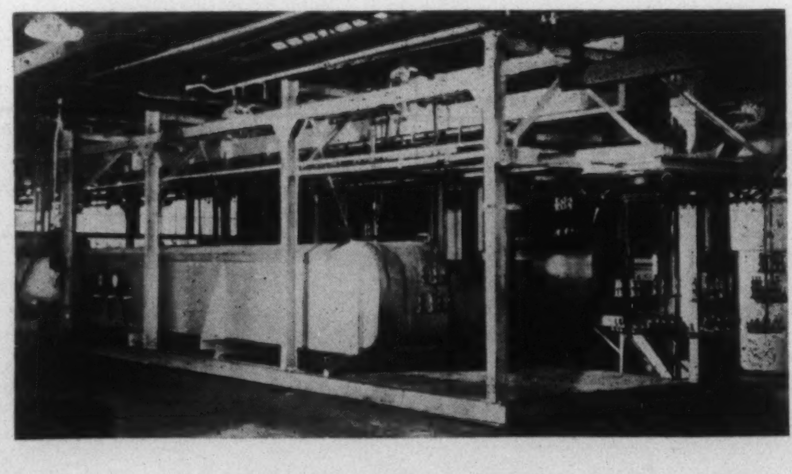
Ajax Hultgren Salt Bath with Continental Automatic Equipment

For UNIFORMITY, ECONOMY AND LOW MAINTENANCE

APPLICATIONS

HARDENING
CARBURIZING
DRAWING
NITRIDING
GRAIN CONTROL
WASHING
PAINTING
BAKING
DRYING

Write Us For Details



SEE OUR WORKING EXHIBIT AT THE NATIONAL METAL EXPOSITION

Continental Industrial Engineers, Inc.
Representatives in Principal Cities
201 N. WELLS ST., CHICAGO, ILL.

(Continued from page P 30)

Electro Metallurgical Co., New York—Booth O-30.
Exhibiting: Recent developments in alloy steels and cast irons will be featured. Charts, specimens, and actual illustrations of industrial uses have been prepared to show the effects of nitrogen and of columbium in chromium steels and in chromium-nickel steels, and numerous applications of alloy cast irons in the automotive field. The use of allloy-bearing briquets in the manufacture of these cast irons will be made clear to visitors at the exposition.

Among the types of alloy steel being featured is the new columbium-bearing 2 to 3 per cent chromium steel.

Elevator Supplies Co., Inc., Hoboken, N. J.—Booth O-9.

Ensign-Reynolds, Inc., New York—Booth, Gas Section.
Exhibiting (in operation): Immersion soft metal furnace. Rotary type air-cooled gas compressor. High pressure ribbon burners with flame distributor and air cleaner, screen burners, "Staylite" burners, gas inspirators. Atmospheric burners and inspirators. Centrifugal air blower. Centrifugal gas booster. Soldering furnaces. Swivel burners for tentering frames.

Firth-Sterling Steel Co., McKeesport, Pa.—Booth D-32.
Exhibiting (in operation): A new "Firth "Braze-Rite" furnace brazing "Firthite" sintered carbide tips onto tool shanks. Late designed Firthite sintered carbide tools. Demonstration charts showing the necessary five steps in the manufacturing of Firthite tools. Models of ingots cast by the Firth winged ingot process. Sterling stainless steel products including steering wheel of the latest design. Many types of Firthaloy wire drawing dies, tube drawing dies, etc., including many other wear resisting parts made of Firthaloy sintered carbides.

J. B. Ford Sales Co., Wyandotte, Mich.—Booth H-22.
Exhibiting: Complete display of Wyandotte specialized metal cleaners for plating, lacquering, enameling, japanning, and vitreous enameling. For use in still solutions, electric cleaning solutions, metal parts washing machines, tumbling barrels, and spray gun equipment. For cleaning before bonderizing, anodizing, hot tinning, galvanizing, and assembling. For removing lacquer, japan, carbonized mineral oils, and fabricating compounds. Wyandotte burnishing compounds for all burnishing problems. Wyandotte neutralizers for neutralizing acid after pickling operations. Wyandotte specialized cleaners for cleaning railway equipment, aeroplane, and automotive equipment.

Cyril A. Fox, Pittsburgh—Booth ½ H-2.
Exhibiting (in operation): New type Fox cut-off machine, used for cutting gates and risers from castings. Cut-off abrasive wheels for use on this machine.

Foxboro Co., Foxboro, Mass.—Booth L-1.
Exhibiting (in operation): Complete line of measurement and control instruments for the metal industries. The potentiometer controller, the potentiometer stabilog with deviation record, the cupola air weight controller, the potentiometer recorder, the temperature stabilog, the pressure stabilog and the pickling tank controller.

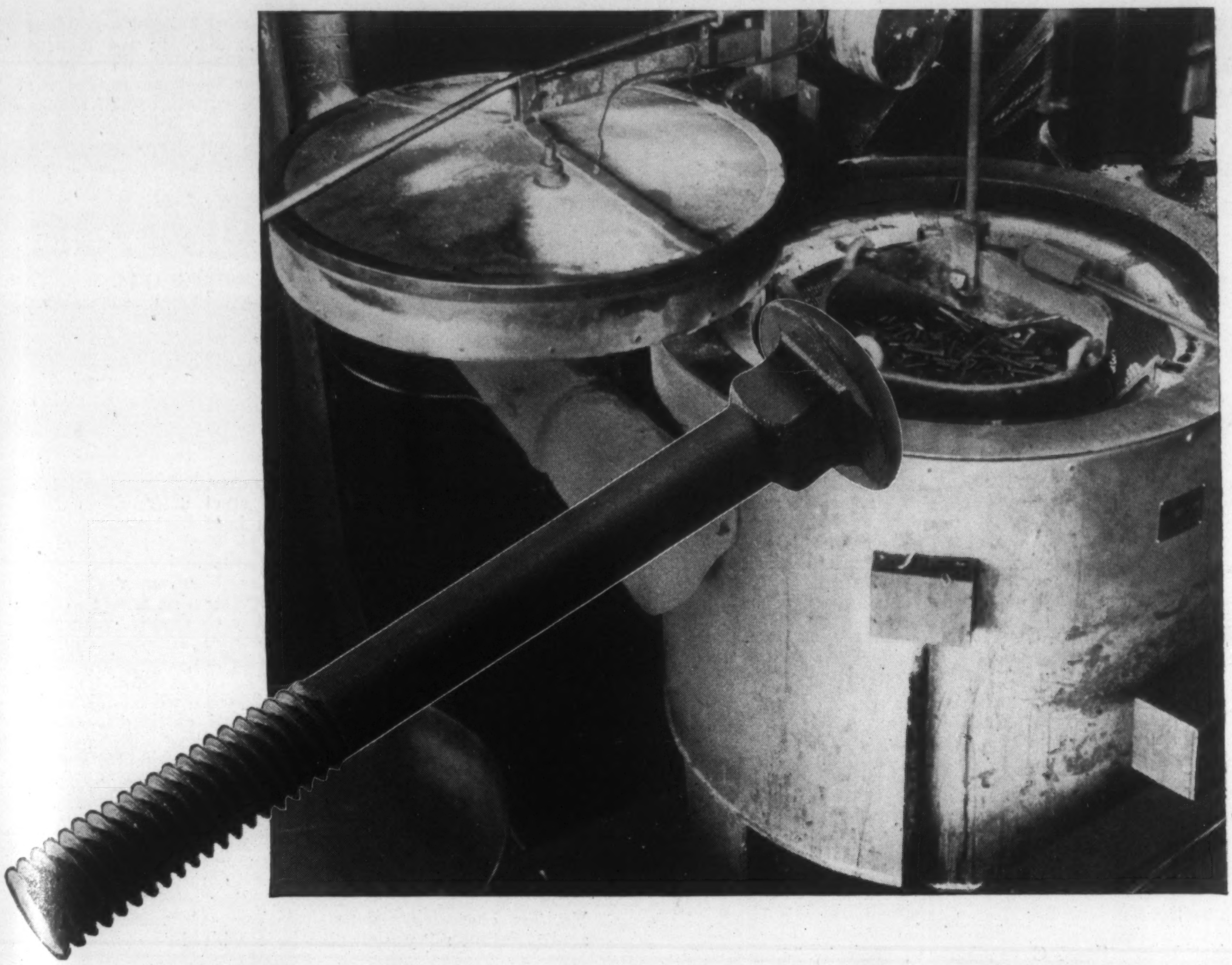
The most interesting instrument to be displayed is the potentiometer stabilog with deviation record. This instrument measures by electricity and controls by air. It combines the unrestricted accuracy of electrical measurement and the extreme flexibility known only to air-operated control. The deviation record is unique in that it is a record of control results only.

A number of improvements and refinements have been made on the other standard Foxboro instruments on display.

Fulton Foundry & Machine Co., Inc., Cleveland—Booth O-33.
Exhibiting: "Meehanite" metal, a special high strength grey iron made by patented Meehanite process. Many samples, and specific castings made of this metal showing the range of applications and the structure of the metal. Photomicrographs and other interesting data.

Gas Machinery Co., Cleveland—Booth, Gas Section.
Exhibiting (in operation): Rotary forge furnace with water seal and syphon vents wherein stock may be heated under controlled temperature and atmosphere, which will insure uniformly heated stock being delivered

(Continued on page P 42)



Physicals Are *Automatically* Uniform In Homo-Normalized Bolts

Better normalizing than ever before is being done by one of the largest bolt plants, since it began to use the Homo-Tempering Furnace shown above. Bolts are more uniform in "physicals", and uniformity is secured automatically — without requiring operator's constant attention to the furnace. He loads the furnace, sets a dial, and goes about other work. At the end of the heat he removes the batch and reloads the furnace. A chart record tells the foreman the number of batches, time of each coming up to temperature and time at soak. With these facts at hand, it is easy to specify any physicals desired. Securing them is also easy, because the Homo Furnace, with its original principle of forced convection and its many vital secondary features, assures highest uniformity of physicals throughout each batch.

If your product contains small parts that require normalizing, drawing, tempering or low-temperature annealing (1500° F. or below), a Homo of correct size (or battery of Homos) can probably do this work more uniformly and more economically.

See Homo Furnaces, Triple-Control Hump Hardening Furnaces, Micromax Pyrometers and Micromax Electric Control at the Metal Show.

LEEDS & NORTHRUP COMPANY
4925 STENTON AVENUE PHILADELPHIA, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES

(Continued from page P 34)

to the forging machine with machine-like precision with practically no scale loss or surface decarburization. Also photographs of recent furnace installations.

Gas Products Co., Cleveland—Booth in 44.

Gathmann Engineering Co., Baltimore, Md.—Booth C-6.

General Alloys Co., Boston—Booth P-8.
Exhibiting: Nickel-chromium alloys, Q-alloys; carburizing and annealing containers; cyanide and lead pots, furnace hearths, roller rails, heat and acid resisting chain, cyanide dipping baskets, recuperators, miscellaneous furnace parts, parts for every type heat treating furnace-carburizing annealing, normalizing, hardening, tempering, forging, spheroidizing, tubes and retorts; corrosion and abrasion resisting castings.

General Electric Co., Schnectady, N. Y.—Booth E-23.
Exhibiting (in operation): An atmosphere-controlled mesh belt brazing furnace. This furnace, which is 30 ft. long, will be in actual operation and the brazing process may be witnessed and the finished parts examined.

A variety of different types of electric welders, including motor generator sets, gasoline driven generator sets and transformers. It will be possible to perform welding with any one of the various welders, and a booth and screen will be provided which will permit several people to witness the welding operation.

General Electric X-Ray Corp., Chicago—Booth E-21.
Exhibiting: General Electric "Hays X-ray" spectrograph and General Electric "Maximar Oilimerst" industrial X-ray apparatus. First showing of this important machine which is completely shock-proof and operates at a capacity of 8 ma. at 200 Kv.p.

Globar Corp., Niagara Falls, N. Y.—Booth O-36.

Gogan Machine Co., Cleveland—Booth N-9.

Claud S. Gordon Co., Chicago—Booth B-18.
See Pyrometer Service & Supply Corp.

Gasselli Chemical Co., Inc., Cleveland.—Booth E-33.

Great Lakes Steel Corp., Ecorse, Detroit, Mich.—Booth P-16.
Exhibiting: Motion picture, showing manufacturing proccesses and also exhibit samples of products fabricated from our material.

Grob Brothers, West Allis, Wis.—Booth E-2.
Exhibiting (in operation): Grob modern die making equipment consisting of open end band saws, other metal band saws, continuous-motion filing machines, and Grob saw band brazing device.

Hamilton Steel Co., Cleveland—Booth P-23.
Exhibiting (in operation): Miniature train operating from mill to warehouse.

Handy & Harman, New York—Booth D-27.
Exhibiting (in operation): Low temperature brazing alloys and silver solders. Various silver clad metals for constructing corrosion resisting containers and equipment as well as electrical contact metals. Brazing with silver alloys will be demonstrated at two stations, the main station showing oxy-acetylene brazing of both ferrous and non-ferrous metals, the other station being devoted to electrical resistance brazing and dip-brazing. In connection with a background illustrating the main points of advantage our products offer, samples of various types of work will be exhibited. Silver clad metals and silver contact metals will also be displayed.

Hardinge Brothers, Inc, Elmira, N. Y.—Booth L-14.
Exhibiting (in operation): BB59 Hardinge "Cataract" enclosed head precision ball bearing bench lathe unit and equipment for tool room, laboratory and production departments.

BB47 Hardinge "Cataract" enclosed head precision ball bearing hand screw machine unit and equipment for production departments.

BB3V Hardinge "Cataract" enclosed head precision ball bearing vertical milling machine unit and equipment for model making, experimental and production departments. A new machine to be introduced.

MD5 Hardinge "Cataract" enclosed head precision pedestal type milling machine for tool room and laboratory purposes. No. 59 Hardinge "Cataract" sleeve bearing precision bench lathe—open cone head model for bench mounting. Various styles of collets for all makes of lathes and milling machines. Various styles of collets and feed fingers for all makes of automatic and hand screw machines.

Harnischfeger Corp., Milwaukee—Booth L-54.

Hauck Mfg. Co., Brooklyn, N. Y.—Booth N-5.

C. I. Hayes, Inc., Providence, R. I.—Booth G-15.
Exhibiting (in operation): "Certain Curtain" atmosphere controlled furnaces, for heat treatment of high speed, carbon and alloy steel tools; high temperature conveyor type copper brazing furnace; type A-4 high speed steel hardening furnace with atmosphere control attachments, and instruments for recording furnace atmosphere; also external atmosphere generator.

Haynes Stellite Co.—Booth O-30.
Exhibiting (in operation): A demonstration of a Haynes Stellite "J-Metal" tool cutting a steel billet, while the tool is continually kept at a red heat by means of an oxy-acetylene flame. Whenever this demonstration of a red hot cutting tool in actual operation has been held previously, interested onlookers have been amazed at the performance of the tool. The demonstration is not given as a life test of the tool, but rather to demonstrate the important property of red-hardness of Haynes Stellite J-Metal, the non-ferrous alloy of cobalt, chromium and tungsten.

In addition to the "red-hot" demonstration, Haynes Stellite will also exhibit other metal cutting tools of Haynes Stellite J-Metal. Included in these will be milling cutter blades, welded-tip tools, solid tool bits and a number of special tools. Together with these will be shown castings of solid Haynes Stellite, and various parts showing the application of hard-facing with Haynes Stellite. In the latter classification will be shown Haynes Stellited steam valves for high-temperature, high-pressure steam service, aircraft and automotive valves and valve seat inserts and numerous other hard-faced parts. Various corrosion-resistant castings of Hastelloy, the acid-resistant alloy, will also be exhibited.

Heat Treating and Forging, Pittsburgh. Booth N-13.
Exhibiting: Business papers.

Hevi Duty Electric Co., Milwaukee. Booth G-25.
Exhibiting (in operation): Miscellaneous electric heat treating equipment.

Hobart Brothers, Troy, O. Booth B-15.
Exhibiting (in operation): The complete line of Hobart "Simplified", 40-volt arc welders in sizes ranging from 75 to 400 amp. Arc welding process on both ferrous and non-ferrous metals—light gage sheet metal and heavy sections—in various applications. Photographs and actual samples of welded parts and assemblies.

O. F. Holden Co., New Haven, Conn. Booth M-18.

Hollup Corp., Chicago.—Booth M-15.

Charles A. Hones, Inc., Baldwin, N. Y. Booth, Gas Section.
Exhibiting (in operation): Gas oven furnaces, high temperature melting furnaces, soft metal furnaces, soldering furnaces, immersion heated tank, industrial gas burners, all requiring no blowers, boosters or power.

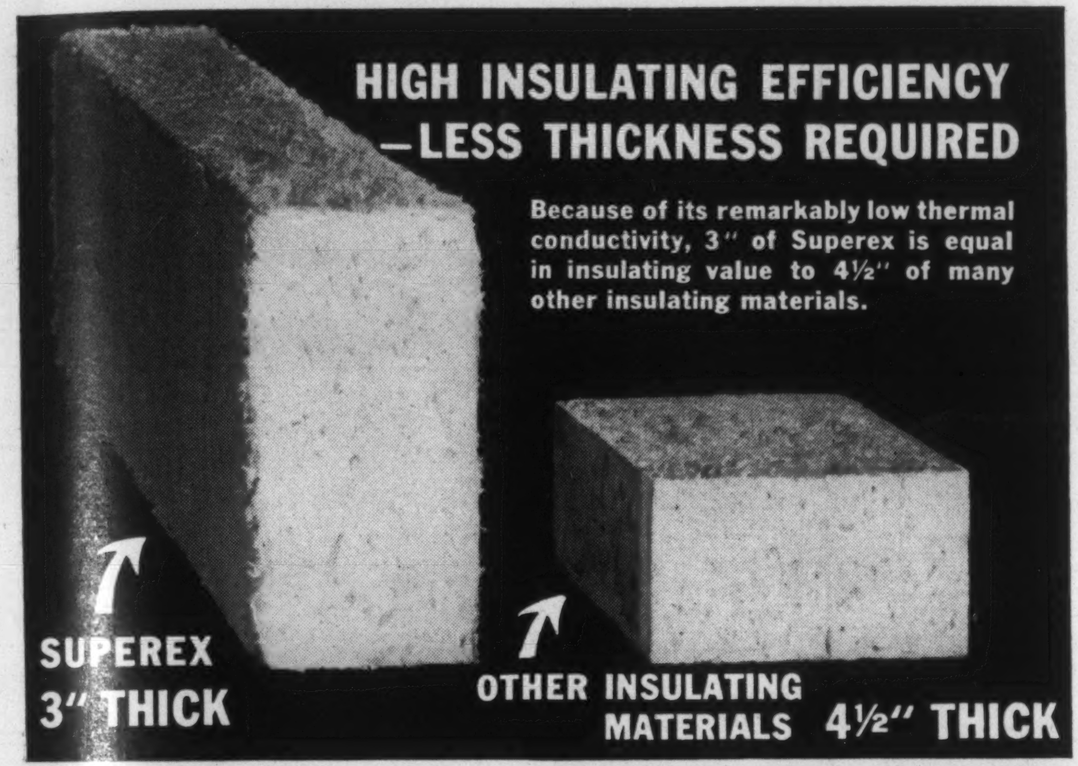
Hoskins Mfg., Detroit. Booth M-59.
Exhibiting: A comprehensive display of Chromel heating element alloys.

E. F. Houghton & Co., Philadelphia. Booth I-8.
Exhibiting: Improvement in pickling inhibitors will be graphically displayed together with charts showing efficiency of Houghton's inhibitors over extended periods of time. "Perliton" liquid carburizer, first introduced at the National Metal Exposition in 1934, will also be featured. A wide range of Perlitonized samples will be on display. New drawing compounds which have enabled automotive and other manufacturers to increase greatly the efficiency of their drawing and stamping, will be

(Continued on page P 44)

SUPEREX- THE MOST EFFICIENT BLOCK INSULATION

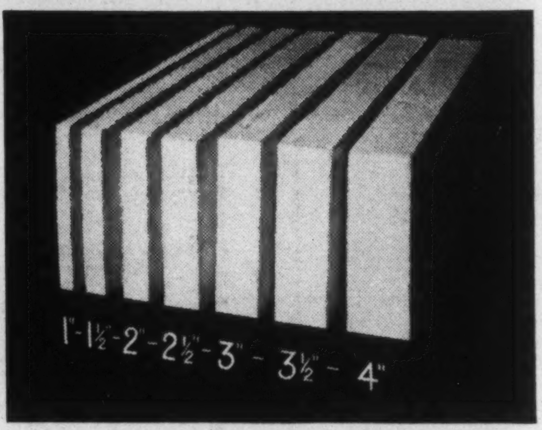
actually costs LESS to install!



HIGH INSULATING EFFICIENCY —LESS THICKNESS REQUIRED

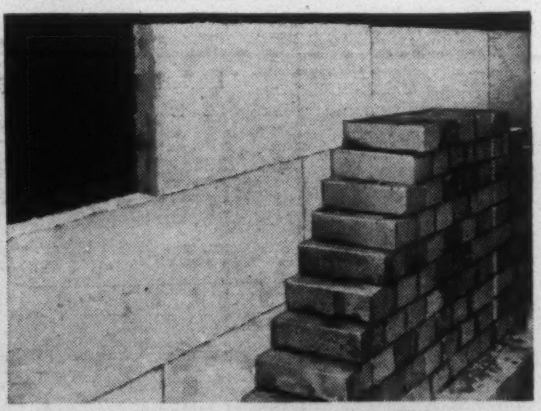
Because of its remarkably low thermal conductivity, 3" of Superex is equal in insulating value to 4½" of many other insulating materials.

SAFE AT HIGH TEMPERATURES. Selected, calcined diatomaceous silica, blended and bonded with asbestos fibre, gives Superex unusual heat resistance. Safe at 1900° F. Stands up under severe service.



PICK YOUR THICKNESS. Superex is furnished not only in the thicknesses shown above, but also in any intermediate thickness desired. No waste; you buy only the thickness you need.

LOW INSTALLATION COST. Blocks are large (up to 12" x 36"); they are light (23 lb. per cu. ft.). Superex goes on quickly, economically—as much as 3 sq. ft. at a time—with savings in labor cost.



JOINT LOSSES MINIMIZED. Whatever insulation you use, however carefully you apply it, there will be heat leakage through joints. Superex's large-size units reduce such losses to a negligible degree.

These are the benefits of using J-M Superex Blocks:

High insulating value that permits less thickness to be used. Result—savings not only in the cost of insulation, but also, in many cases, additional savings in furnace-construction costs. Large . . . light . . . Superex Blocks go on quickly and smoothly (covering as much as three square feet at a time), send labor costs down and actually save money at installation!

Hence . . . Superex has definitely proved itself the most efficient and economical block insulation for high-temperature industrial equipment. Safely withstanding all temperatures up to 1900° F., these blocks retain their high insulating effectiveness even under severe service conditions.

You will find Superex especially well adapted for the insulation of slab-heating, annealing and all types of controlled-atmosphere furnaces, producer-gas mains, hot-blast stoves, open hearths and regenerators, and soaking pits.

Engineering data sheets on Superex Blocks, Sil-O-Cel Brick and other Johns-Manville Insulations for high-temperature equipment may be had by addressing Johns-Manville, 22 E. 40th St., N. Y. C.

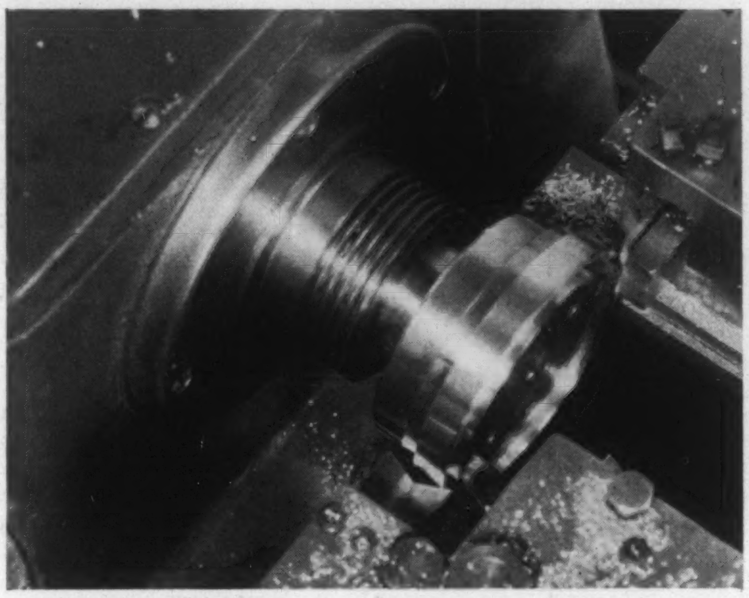
Johns-Manville
INDUSTRIAL INSULATIONS

JOHNS-MANVILLE
JM
PRODUCTS

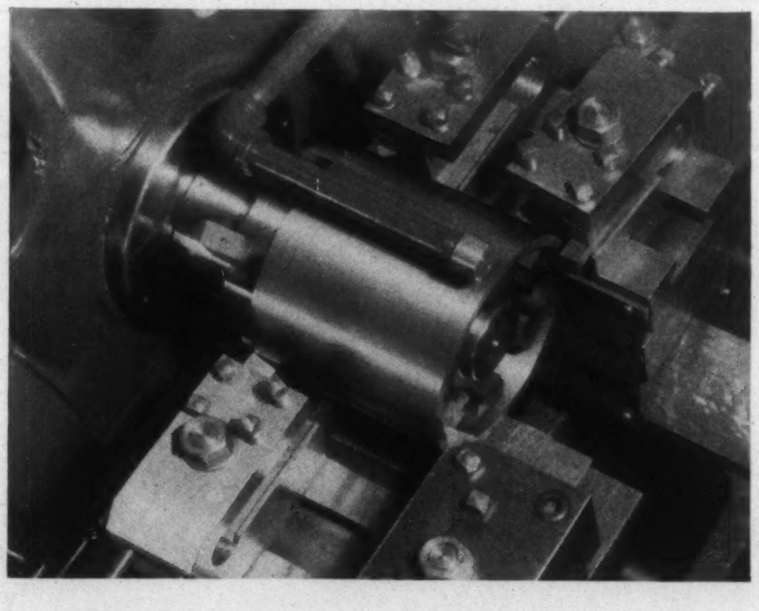
For every temperature condition from 400° F. below zero to 3000° F. above

J-M Insulations on display at Booth N-38, National Metal Exposition, Cleveland, October 19-23, 1936

THERE IS A FIRTHITE TOOL FOR EVERY JOB



A FIRTHITE tool set-up for turning brass automotive transmission rings at a speed of 550 ft. per min. Production is at the rate of 125 pcs. per hour with a tool life of 2000 pcs. per grind.



FIRTHITE tools turning, facing and chamfering a 6 inch diameter semi-hard cast-iron sleeve at a speed of 250 ft. per min., with a tool life of 500 pcs. per grind.

No matter whether it's turning, facing, boring, milling or reaming of cast iron, malleable iron, brass, bronze or aluminum; or for nonmetallic materials such as bakelite, rubber, fiber or glass there is a FIRTHITE tool to do the job and do it faster and better.

FIRTH-STERLING STEEL COMPANY

Works: McKeesport, Pa.
New York Chicago
Hartford Cleveland
Detroit Los Angeles
Philadelphia Dayton
Globe Wire Division
McKeesport, Pa.

(Continued from page P 42)

shown, together with samples of work done by the aid of these materials. An improved series of metal cleaners combining features heretofore not found in the average alkali cleaner, will be announced at this exposition. Recent developments in cutting oil which combine the necessary features of refrigeration, film strength and lubrication will be graphically presented. New wire drawing agents will likewise be shown, with proof of their efficiency. 'Stay-Put" industrial lubricants will be included in the exhibit, as well as "Vim Tred" leather belting, leather packings and Houghton's No. 2 soluble quenching oil.

Illinois Testing Laboratories, Inc., Chicago. Booth N-26. Exhibiting (in operation): "Alnor" portable and stationary, single and multi-point indicating pyrometers, distant reading thermometers (resistance type) and air velocity meters.

Industrial Publishing Co., Cleveland. Booth P-24. Exhibiting (in operation): Periodicals and showing typical redesign of machines and structures for fabrication by welding, and the application of the newer alloy materials in welded design.

Ingersoll-Rand Co., Phillipsburg, Pa. Booth N-45.

International Nickel Co., Inc., New York. Booth B-7. Exhibiting: Alloys of nickel both ferrous and non-ferrous.

Industrial Press, New York. Booth O-21. Exhibiting: The Magazine "Machinery" and "Heating and Ventilating" as well as technical books.

Iron Age, New York. Booth O-48. Exhibiting: Current copies of *The Iron Age.*

Iron & Steel Publishing Co., Pittsburgh. Booth O-34. "Finishing," the journal of the metal finishing industries, also copies of the supplement "Grinding—Polishing and Buffing."

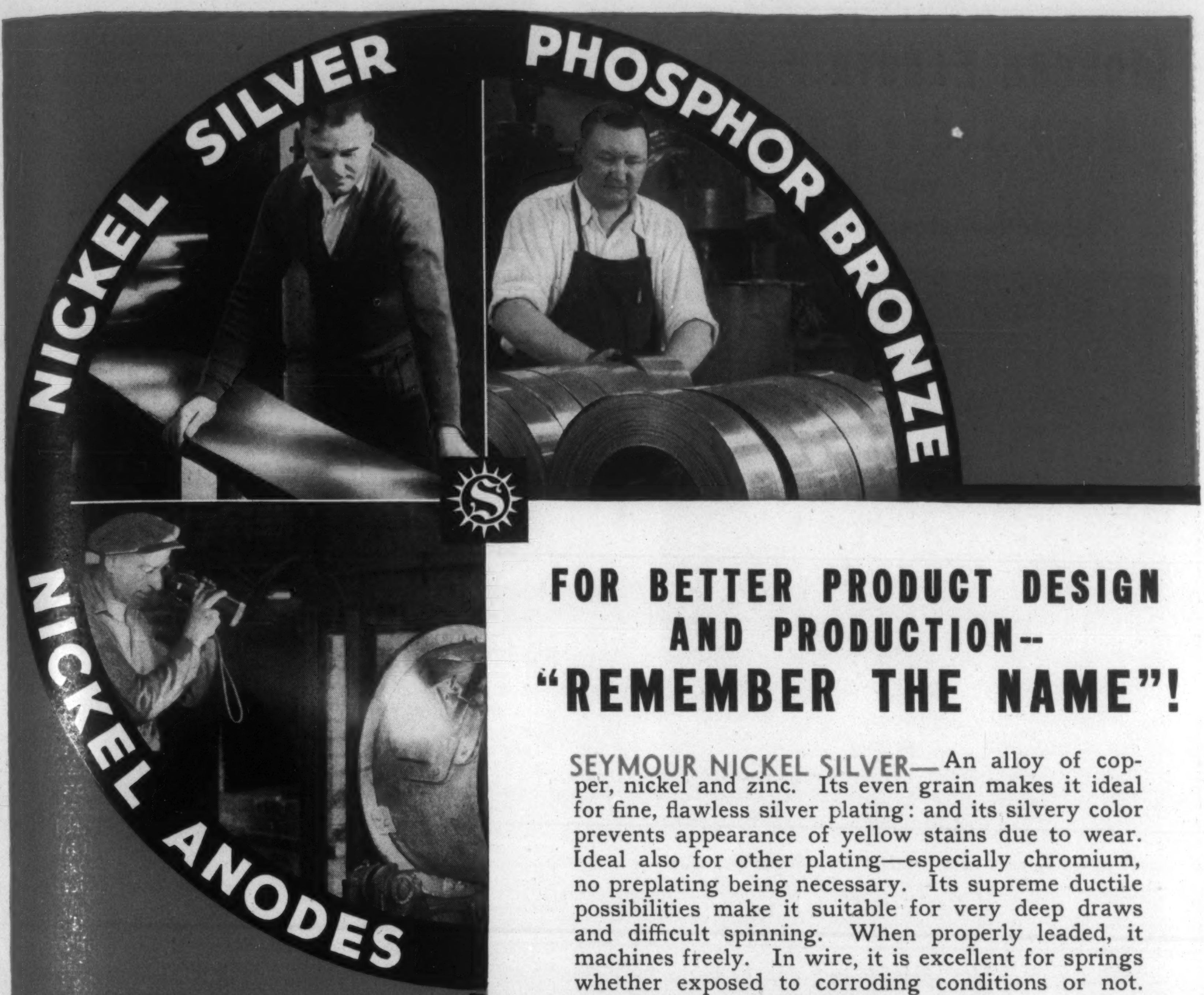
C. O. Jelliff Mfg. Co., Southport, Conn.—Booth N-11.

Johns-Manville Corp., New York.—Booth N-38. Exhibiting: Complete line of insulating and refractory materials, of which the following will be featured:

1. "Superex" blocks for insulating behind refractory linings in hot blast stoves, mains and bustle pipes; open hearth furnaces and regenerator systems; soaking pit regenerators; producer gas mains; and controlled atmosphere and various other types of high temperature furnaces.
2. "Sil-O-Cel" C-22 brick for use as a combination insulating and refractory lining in furnaces operating at temperatures up to 2000 deg. F.
3. "Sil-O-Cel" C-3 concrete, for temperatures up to 1800 deg. F., a semi-refractory insulating concrete lining for furnace doors and for insulating furnace floors and bases.
4. Firecrete, a hydraulic-setting, monolithic refractory used at temperatures up to 2800 deg. F. for poured door linings, flues and pipes; for dampers and special shapes.

Jones & Laughlin Steel Corp., Pittsburgh. Booth E-15. Exhibiting (in operation): A large scale working model of a tilting open hearth furnace which by a unique arrangement of lights and liquid represents, with effective realism, the operation of tapping a heat of steel. Supplementing this central feature is an interesting and comprehensive display of steel products and parts. Of particular interest to technical and operating men are the exhibits and demonstrations that reveal qualities of carbon steel products in their various grades and finishes. By a series of large illuminated photomicrographs, J & L tells an interesting story of the properties and qualities of coarse and fine grain forging steel, and in addition there is a most unusual assortment of rough forgings to be seen. Also on display are other hot rolled products including Jalcase steel and various parts made of it. Also a display of J & L cold finished steel products including improved Bessemer screw stock, special cold drawn shapes, cold finished Jalcase, shafting and wide cold rolled flats. Another feature is a specially designed and constructed fatigue testing machine which is in operation testing a spring unit made of J & L spring

(Continued on page P 46)



FOR BETTER PRODUCT DESIGN AND PRODUCTION-- "REMEMBER THE NAME"!

SEYMOUR NICKEL SILVER—An alloy of copper, nickel and zinc. Its even grain makes it ideal for fine, flawless silver plating: and its silvery color prevents appearance of yellow stains due to wear. Ideal also for other plating—especially chromium, no preplating being necessary. Its supreme ductile possibilities make it suitable for very deep draws and difficult spinning. When properly leaded, it machines freely. In wire, it is excellent for springs whether exposed to corroding conditions or not. Samples for test on request.

SEYMOUR PHOSPHOR BRONZE—An alloy of copper, tin and phosphorus. Highly resistant to corrosion. Indifferent to sudden thermal change. Has extreme resilience and ability to withstand friction and abrasion. Much used for flat and coiled springs, particularly in electrical service, and, when leaded, for screw machine parts. Samples and explanatory book on request.

SEYMOUR NICKEL ANODES—Made of virgin nickel, cast in a modern electric furnace, where grain structure is pyrometrically controlled. After pouring, samples of each melt are rigidly analyzed and only those samples which show a high degree of homogeneity pass inspection. Seymour Anodes are also made in copper, brass, bronze and zinc. Anode Book free.

THE SEYMOUR MANUFACTURING CO.
63 Franklin St., Seymour, Conn.

SEYMOUR

MODERN ELECTRIC HIGH SPEED FURNACES

with

Complete Atmospheric Control

AEF
American Electric Furnace Co.
Boston, Mass.

Model HB-20 Furnace with "AMERICAN" Atmospheric Control and Gas & Air Dehydrating Cylinders. Chamber 12" x 18" x 8"

When the United States Navy buys high speed electric furnaces they buy "AMERICAN"

BECAUSE

"AMERICANS" have:—

the one Atmospheric Control that has been definitely proved—

Uniform temperature distribution without dark corners or cold hearths—

An unmatched record of success at leading industrial plants—

Exceptionally low operating cost.

BUY "AMERICAN"

Ask for information today

American Electric Furnace Co.

29 Von Hillern Street, Boston, Mass.

All Types Industrial Furnaces

(Continued from page P 44)

wire, and an interesting assortment of parts made of J & L cold heading wire. This display presents an opportunity for learning more about the advantages of using the right grade of tin plate for special purposes.

J. W. Kelley Co., Cleveland. Booth H-16.
Exhibiting (in operation): Heat-treating products, industrial oils, special exhibit of grinding oil.

Kelly-Koett Mfg. Co., Chicago. Booth A-18.

C. M. Kemp Mfg. Co., Baltimore. Booth, Gas Section.
Exhibiting (in operation): Industrial carburetor for premixing air and gas. Demonstration of submerged combustion equipment for pickling tanks. Atmos-gas producer for deoxidized annealing.

G. N. Krouse, New Kensington, Pa. Booth Q-20.
Exhibiting (in operation): Cantilever type high speed fatigue machines testing inexpensive specimens at 10,000 cycles per minute. High speed fatigue machines equipped with a new wire testing attachment having a speed range of from 500 to 12,000 cycles per minute. Sheet fatigue testing machine adapted for range of repeated stress investigations of sheet metals.

La Salle Steel Co., Chicago. Booth N-50.

Lakeside Steel Improvement Co., Cleveland. Booth O-22.
Exhibiting: Examples of general heat treating, nitriding, chapmanizing, carburizing, aerocasing, blueing, flame hardening.

Leeds & Northrup Co., Philadelphia. Booth I-15.
Exhibiting (in operation): The complete "Micromax" family of temperature instruments, consisting of the new silver anniversary strip-chart recording controller, round-chart recorder, indicating controller, and non-indicating controller. A special demonstration of Micromax electric control will show how temperatures are regulated by proportioning heat-input to demand. Three control systems are available—without droop corrector, with manual droop corrector, or with automatic droop corrector. Each element of the system works with Micromax sensitivity and accuracy.

A new "Homo" furnace will be displayed for the first time. It is a smaller model, designed for tool or die tempering, and embodies the Homo principle of uniform heating. A dense load Homo furnace will also be in operation, and temperature-exploration tests will be run at frequent intervals to show the speed and uniformity of heating. Triple-control hump hardening furnace will be in operation to demonstrate control of atmosphere, rate of heat-input and quench point. Anyone bringing a sample test piece to the booth may have it hardened.

E. Leitz, Inc., New York. Booth H-14.
Exhibiting (in operation): Leitz large micro-metallograph MM-1 for observation of ordinary reflected light, polarized reflected light and dark field. Leitz simplified micro-metallograph MM-2 with new type mercury vapor illuminator. Leitz dilatometer for the thermal analysis of metals by means of automatically recording. This is the latest model with improved transmission system. Leitz universal microscope and photomicrographic apparatus "Panphot" permitting the use of any type of illumination for micro and macro investigations. Leitz large workshop microscope for testing of smaller machine parts, screwthreads, etc. Guthrie-Leitz automatic polishing machine with mechanical rotation device for the rotation of the specimen, newly developed speed control for AC or DC operation. Leitz "Leica" camera and accessories. Leitz "Tyndallometer" for the direct measurement of the dust concentration of the atmosphere,—a new instrument in the field of industrial hygiene.

Lewis Machine Co., Cleveland.—Booth L-10.

Lincoln Electric Co., Cleveland.—Booth F-23.
Exhibiting (in operation): The new dual continuous control introduced on the "Shield-Arc S. A. E." welder. By making possible the selection of any degree of arc penetration for each and every current setting, this new control provides a distinct advancement in welding technique. Both voltage and current of the new welder can

(Continued on page P 48)

"OK"

Heat treaters, everywhere, have placed their stamp of approval on

PERLITON

At home and abroad—over the metal industry there are many echoes of that approval, as more and more men turn to Perliton Liquid Carburizer as the answer to their problems. Especially adaptable for carburizing of small parts in production, Perliton has fast become a worthy member of the Houghton Line of metal-working products.

At the left is 100x photo of .15/.25 carbon steel carburized in Perliton for 2 hrs. at 1600° F. (871° C.) and quenched in brine. Customer who made it reports "much quicker and more economical than pack hardening."

Begun in 1865, the Houghton Organization attained early prominence with its introduction of the first controllable carburizer that was the fore-runner of many improvements in case-hardening of steel.

Realizing that quenching was as important as heating, Houghton research developed No. 2 Soluble Quenching Oil—a world standard for uniformity and depth of hardness.

Add to these, such outstanding products as Houghton's Draw Temps for drawing and tempering. . . . "Liquid Heats" for annealing and hardening. . . pickling inhibitors. . . cutting oils . . . general and special purpose lubricants. Indeed a record for research and service to the metal-working industry has been established.

The Houghton Line is a good one to cling to when you need help or want to improve your processes and reduce costs.

E. F. HOUGHTON & CO.

Chicago - PHILADELPHIA - Detroit

Recent developments in heat treating and metal working will be graphically displayed at the Houghton Exhibit in the National Metal Exposition, Booths I-8 and I-9. Straight ahead at the end of the aisle as you enter the show.

You Can Have
"ALL THREE"

Through nearly a quarter century of successful performance, AMPCO METAL has proved to hundreds of Designers, Metallurgists, Maintenance Engineers and other executives of industry that it excels in . . .

1. Extreme wear resistance
2. High physical properties
3. Economy

Time and again AMPCO METAL has *proved* its versatility in a wide variety of adaptations . . . has *proved* not only that it can outlast other bronzes in difficult services, but that it actually can outwear hardened steel in many cases . . . has *proved* that in some one of its six grades it can conquer a lot of problems that can't be licked with other metals.

You may know something about AMPCO METAL . . . you may consider it ideal for certain specialized requirements . . . but you may be overlooking many of its other valuable qualifications. If you go to Cleveland for the National Metal Exposition and Congress, get re-acquainted with AMPCO METAL and let's discuss your specific requirements . . . or

WRITE FOR CATALOG 21

"AMPCO METAL—Its Uses in Modern Industry" which you will find well worth serious study.

AMPCO METAL, Inc. MILWAUKEE, WIS.

AMPCO

"The Metal without an Equal"

(Continued from page P 46)

be varied in a continuous sequence of fine increments. Another recent Lincoln welder development . . . the new "SA-150" . . . will also be demonstrated. This small welder, with a rated capacity of 45 to 200 amperes, is insulated with Class "B" (non-inflammable) insulation, permitting operation at sustained peak loads without danger of burn-outs.

Latest developments in arc welding electrodes will be shown and demonstrated. These include "Toolweld" for hard-facing tools and dies; "Aerisweld" for welding bronze, brass and copper; "Chromeweld 4-6" for welding 4-6 per cent chromium steel, and a dozen other electrodes for welding various metals and alloys. Also, there will be a full line of the latest in electrode holders, welding cable, protective shields with the new non-splatter lens, etc.

Lindberg Engineering Co., Chicago.—Booth L-33.
Exhibiting (in operation): Cyclone furnaces, gas and electric, in operation. Special demonstration of new Lindberg throttling valve. Screw type pot furnace for lead, cyanide, etc.

Linde Air Products Co., New York.—Booth O-30.
Exhibiting (in operation): Recent outstanding developments of the oxy-acetylene process, and the advances of machine cutting will be particularly featured. Several of the latest cutting machines will be on view to show how the demands for various applications of flame cutting have been answered with specially designed equipment. The new Oxweld type CM-12 shape cutting machine, which covers a scope of work hitherto impossible with one machine, will be in actual operation.

Several new acetylene generators which have been introduced during the past few months will be shown and a new line of Oxweld oxygen and acetylene regulators will be represented together with the latest in hand cutting and welding blowpipes. Live demonstrations will portray some of the recent advancements in oxy-acetylene welding procedures and equipment.

Macklin Co., Jackson, Mich.—Booth C-26.
Exhibiting (in operation). Display of grinding wheels. Cut-off machine in operation. Enlarged photographs of grinding operations.

Magnaflux Corp., Chicago.—Booth N-15.

Magnetic Analysis Corp., Long Island City, N. Y.—Booth D-4.
Exhibiting (in operation): The dual method type magnetic testing equipment and the laboratory type inductoscope equipment for the rapid non-destructive inspection of steel will be displayed.

Mahr Mfg. Co., Minneapolis, Minn.—Booth N-44.

P. R. Mallory & Co.. Inc., Indianapolis.—Booth H-26.
Exhibiting: A display of Mallory metals and alloys—"Elkonite," "Elkaloy A Metal," "Mallory 3 Metal," "Mallory 53 Metal," "Mallory 100 Metal"—and all types of Mallory water-cooled holders. Spot welding tips, seam welding wheels, flash welding dies and various forms of castings, forgings and special shapes. A special display of gun welders equipped with Mallory arms and tips. Examples of spot welding of dissimilar metals and display showing difficult welds. Animated display showing differences in properties of Mallory metals and copper. Exhibit of Mallory electrical contacts and contactors of tungsten and molybdenum, Elkonite, platinum, silver, nickel, copper, or their alloys. Large photographic murals, picturing and describing actual results of Mallory metals on difficult welding operations.

Manhattan Rubber Mfg. Division, Passaic, N. J.—Booth H-2.
Exhibiting (in operation): Abrasive cut-off wheels cutting alloy castings. Finishing wheels for stainless steel of a new type, recently developed, which produce a much improved finish.

John A. Manning Paper Co., Inc., Troy, N. Y.—Booth M-1.
Exhibiting: Rope papers and methods of applying same to copper wires as insulation for use in the manufacture of electrical equipment. Rag, woodpulp and blended fibre papers used as motor slot insulation and trans-

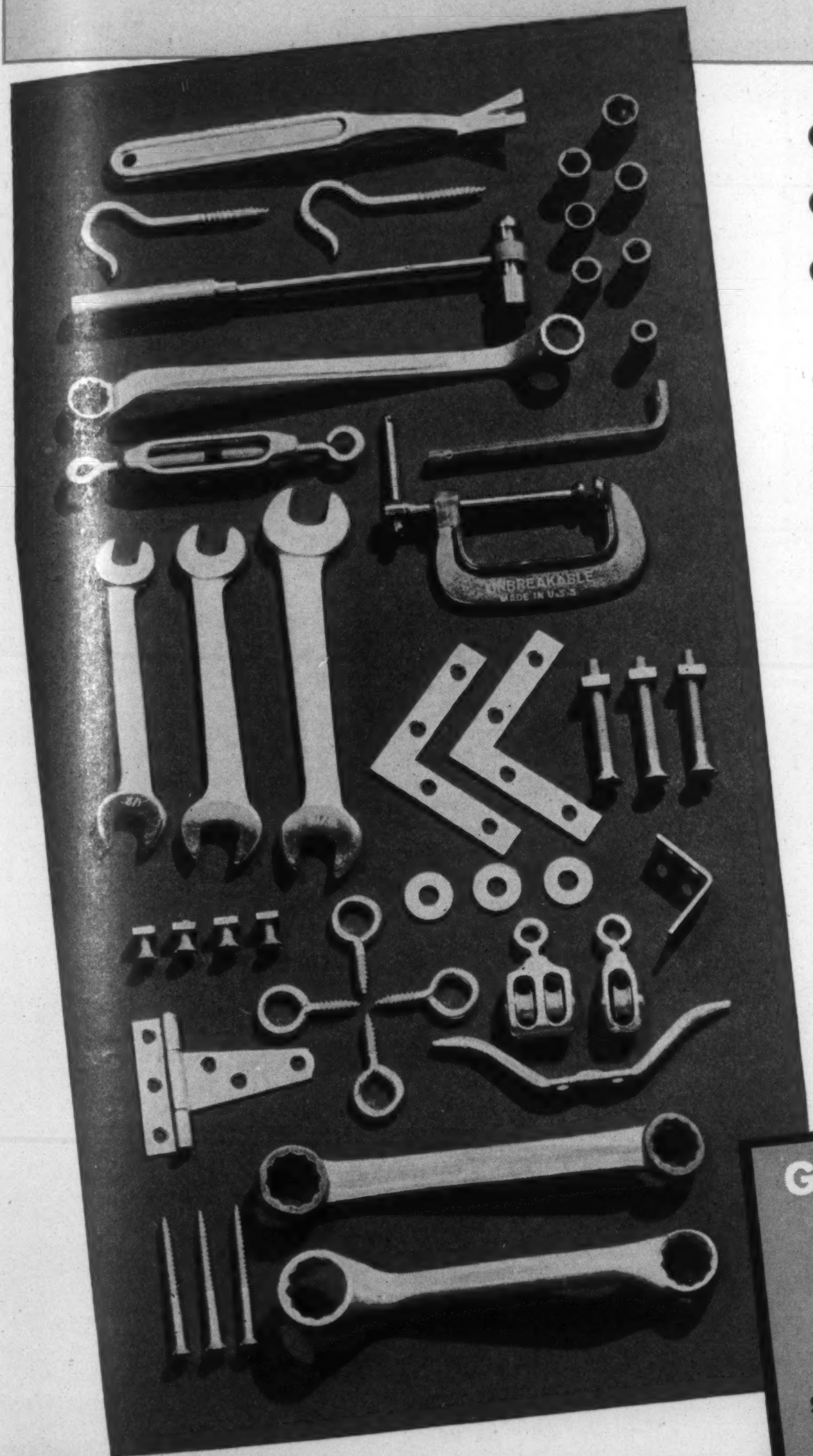
(Continued on page P 50)

BETTER PLATING and LOWER COSTS

CADALYTE

a Process and Product for

CADMIUM PLATING



CADALYTE is more EFFICIENT

CADALYTE is more ECONOMICAL

CADALYTE is more ENDURING

★

The CADALYTE* Process of cadmium plating provides a maximum degree of rust-protection. It affords complete protection of iron and steel products by an electrodeposit of 100% pure metal. It assures a rust-proof coating which embodies the desirable characteristics of brilliancy, density, ductility and absolute adherence.

The stability of the CADALYTE solution, its high throwing power, low resistance, high and equal cathode and anode current efficiencies, its ability to accommodate high current densities, and its simplicity of maintenance, all contribute to effect economies which make the CADALYTE Process outstanding in the field of metal finishing. Write for further information.

* *Trade Mark Registered*

GRASSELLI BRIGHT ZINC

An electroplating zinc process which produces a brilliant finish, an excellent protection against rust, with the advantages of economical zinc plating.

●

See our display of Electroplating Chemicals and Equipment at The National Metal Congress, Cleveland—Oct. 19th to 23rd, 1936

THE GRASSELLI CHEMICAL COMPANY, INC.

GRASSELLI

FOUNDED 1839 CLEVELAND, OHIO

NEW YORK AND EXPORT OFFICE: 350 FIFTH AVENUE

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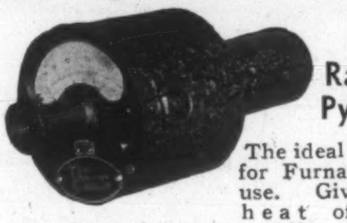
BRANCHES AND WAREHOUSES: Albany, Birmingham, Boston, Charlotte, Chicago, Cincinnati, Detroit, Milwaukee, New Haven, New Orleans, Philadelphia, Pittsburgh, St. Louis, St. Paul, San Francisco, 584 Mission Street, Los Angeles, 2260 East 15th Street

Represented in Canada by CANADIAN INDUSTRIES, Ltd. General Chemicals Division—MONTREAL and TORONTO



PYRO THE SIMPLIFIED OPTICAL PYROMETER

The Only Self-Contained, Direct Reading, Rugged and Fool-Proof Instrument for Forge Shops, Heat Treating Plants, Steel Plants and Foundries, Laboratories, Etc.

Unique construction enables operator to rapidly determine temperature even on minute spots, fast moving objects or smallest streams; no correction charts, no accessories. Special "FOUNDRY TYPE" has in addition to its standard calibrated range, a red correction scale determining TRUE SPOUT and POURING TEMPERATURES of molten iron and steel when measured in the open.

PYRO OPTICAL is NOW available in a NEW TYPE with THREE SEPARATE, DIRECT READING SCALES—the ideal instrument for universal steel mill uses, open hearths, soaking pits, rolling mills, laboratories, etc.

Stock ranges 1400°F. to 5500°F.

Pyro Radiation Pyrometer

The ideal instrument for Furnace or Kiln use. Gives actual heat of material aside from furnace or kiln temperature. Does not require a skilled operator,—strictly automatic. Eliminates personal errors. Always ready to tell within three seconds any shortcomings in your equipment. Stock Ranges 1000° to 3600°F. Write for special bulletins.

The Pyrometer Instrument Co.
105 Lafayette St., New York, N. Y.
Grant Building, Pittsburgh, Pa.
See our instruments exhibited Booth B-18
National Metal Exposition

RODINE

MAKES PICKLING EFFICIENT

- UNIVERSAL ADOPTION. Rodine is cutting costs in 95 per cent of the country's pickling rooms.
- SAVES ACID AND METAL. Rodine more than pays for itself. By its use, economies of 30 to 60 cents per ton of metal pickled, are frequently gained.
- PREVENTS OVERPICKLING. Rodine eliminates pitting of the metal, minimizes acid brittleness, reduces rusting of pickled stock.
- SIMPLE TO USE. And by Rodine's use, the pickling operation is easily controlled and consistent in results.

•

Complete information, samples and prices, may be secured by addressing

AMERICAN CHEMICAL PAINT CO.
AMBLER PENNSYLVANIA
Detroit
6339 Palmer Ave. E.

(Continued from page P 48)

former insulation. Numerous specialty papers such as papers containing cork, papers for radio speakers, papers for artificial leather and various other specialty purposes.

Marburg Brothers, Inc., New York.—Booth L-50.

Metal Industry, New York.—Booth N-59.

Metals & Alloys. New York.—Booth B-2.
Exhibiting: METALS AND ALLOYS, "The Magazine of Metallurgical Engineering." Also, metallurgical books.

Metal & Thermit Corp., New York.—Booth H-27.
Exhibiting (in operation): The complete line of "Murex" heavy mineral coated electrodes together with a number of test specimens and sample welds made with Murex. A welding booth for demonstrating electrodes. Sample welds and equipment for welding by the Thermit process.

Michiana Products Corp., Michigan City, Ind.—Booth N-14.
Exhibiting: Nickel chromium heat resistant castings; chrome nickel stainless steel castings; alloy sheet fabricated dampers; centrifugally cast products, including steel mill rolls. Carburizing pots; and tubing.

Michigan Steel Casting Co., Detroit.—Booth I-14.
Exhibiting: We will exhibit for the first time "Misco" centrifugally cast furnace conveyor rolls. No mechanical points are used in the construction of these rolls as the end castings are flash welded to the centrifugally cast tube. Centrifugally cast carburizing and annealing containers, pipe and tubing and other centrifugally cast products.

Another new development we are exhibiting for the first time is a pusher type chain. We expect to have a strand of this chain in operation. Thermocouple protection tubes, chain and belt conveyors, and insulated blast furnace blow pipes, and numerous other castings covering a broad field of application for heat and corrosion resistant alloys.

The Midvale Co., Nicetown, Pa.—Booth B-14.
Exhibiting: Hardened and ground roll—large size.

A. Milne & Co., New York.—Booth D-22.
Exhibiting: Tool and die steels; hollow, solid and auger drill steels; and alloyed and carbon tool steels.

Modern Machine Shop — Products Finishing (Magazines), Cincinnati.—Booth M-14.
Exhibiting: Displays featuring the two publications, *Modern Machine Shop* and *Products Finishing.*

Molybdenum Corp. of America, Pittsburgh.—Booth O-24.
Exhibiting (in operation): Diorama effect exhibiting molybdenum and tungsten alloys.

Monarch Steel Corp., Indianapolis.—Booth M-55.

Morse Magneto Clock Co., New York.—Booth O-47.

Mullite Refractories Co., Shelton, Conn.—Booth O-15.

National Cylinder Gas Co., Chicago.—Booth M-44.
Exhibiting (in operation): "Corta" oxy-acetylene cutting machine. An advanced model cutting machine, designed to do all types of cutting, such as straight lines automatically, circles, irregular shapes of all types and kinds, either manually by following the lines of a drawing, or automatically with the use of a template.

National Industrial Publishing Co., Pittsburgh.—Booth O-27.
Exhibiting: "Industrial Heating"—a monthly publication, devoted to all industrial heating processes, furnaces, ovens, kilns, etc., as used in the manufacture and treatment of iron, steel, non-ferrous metals, glass, ceramic products, etc.

National Tube Co., Pittsburgh.—Booth C-15.

National Tube Co., Pittsburgh, (United States Steel Corp. Subsidiary).—Booth C-15.
Exhibiting: See "United States Steel Corp. Subsidiaries."

(Continued on page P 52)

3 HOURS of CHAPMANIZING

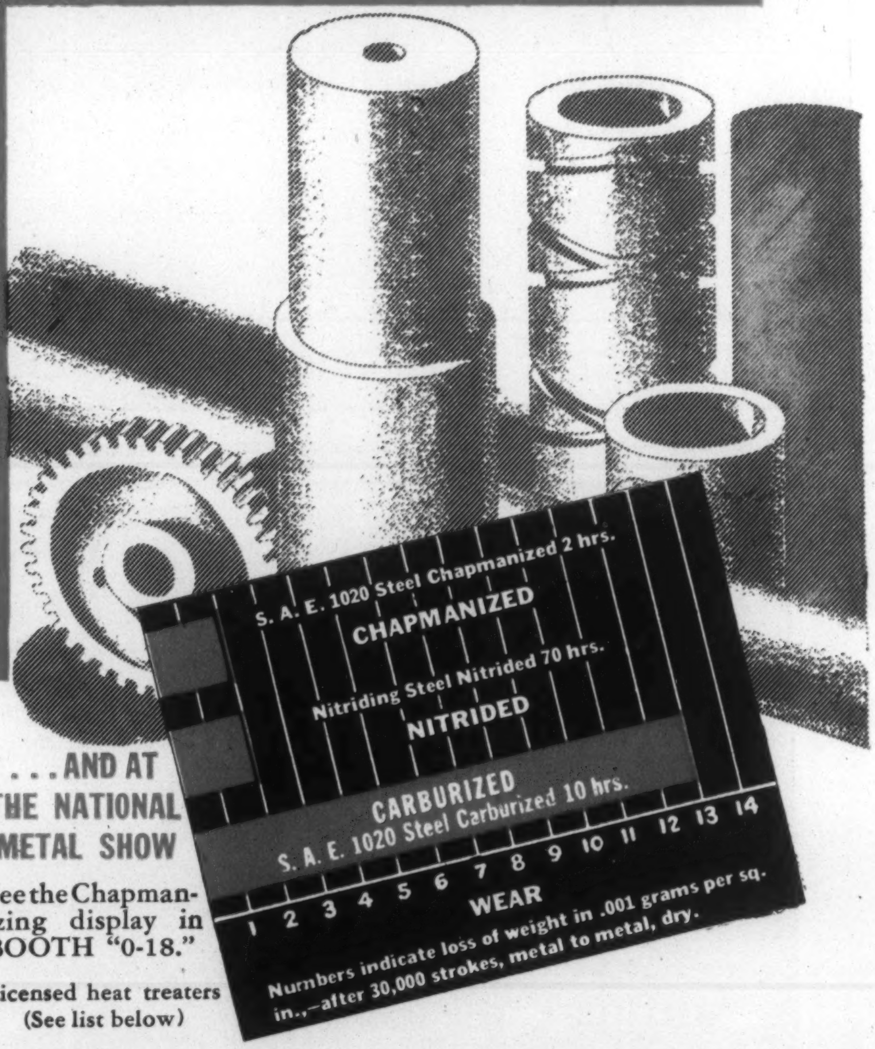
OUTWEARS 10 HOURS of CARBURIZING

....and equals the hardness of alloy steels

In the metal-working and manufacturing industries, these are every-day results with Chapmanizing. Here's what this exclusive process is doing:

1. It's cutting material costs and operating overhead by giving low-cost, low-carbon steels the wearing qualities of expensive alloys . . . giving them hardness up to 1000 Brinnell.
2. It's producing—in ⅓ the time—a surface that gives 9 times the wear of a carburized surface.
3. It's reducing hardening time to the minimum—in some cases to 1/20th, for comparable results. And it's reducing hardening costs accordingly.
4. It's slashing the time required for machining and finish grinding.
5. It's providing a case of any depth from .002" to .035" —tough, yet so ductile that it does not chip, flake or crack under bending, abrasion or sliding pressure . . . and does not appreciably warp or distort under processing to close tolerances.
6. It's producing a clean, bright, silvery finish that resists corrosion by atmosphere, steam, or hot gases.

Applications are unlimited. Costs are low, for you can utilize your present equipment. Or you can send your work direct to Chapman. Send today for illustrated book describing the Chapmanizing process—how it compares with other methods—how it gives longer wear at less cost.



. . . AND AT THE NATIONAL METAL SHOW

See the Chapmanizing display in BOOTH "0-18."

Licensed heat treaters (See list below)

COMMERCIAL LICENSEES

Lindberg Steel Treating Company
Chicago, Illinois

Lakeside Steel Improvement Co.
Cleveland, Ohio

Wesley Steel Treating Company
Milwaukee, Wisconsin

Alfred Heller
New York City

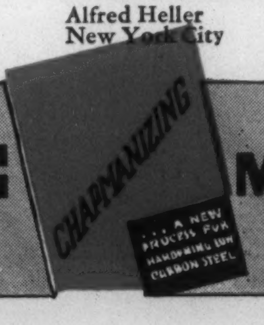
Commercial Steel Treating Corp.
Detroit, Michigan

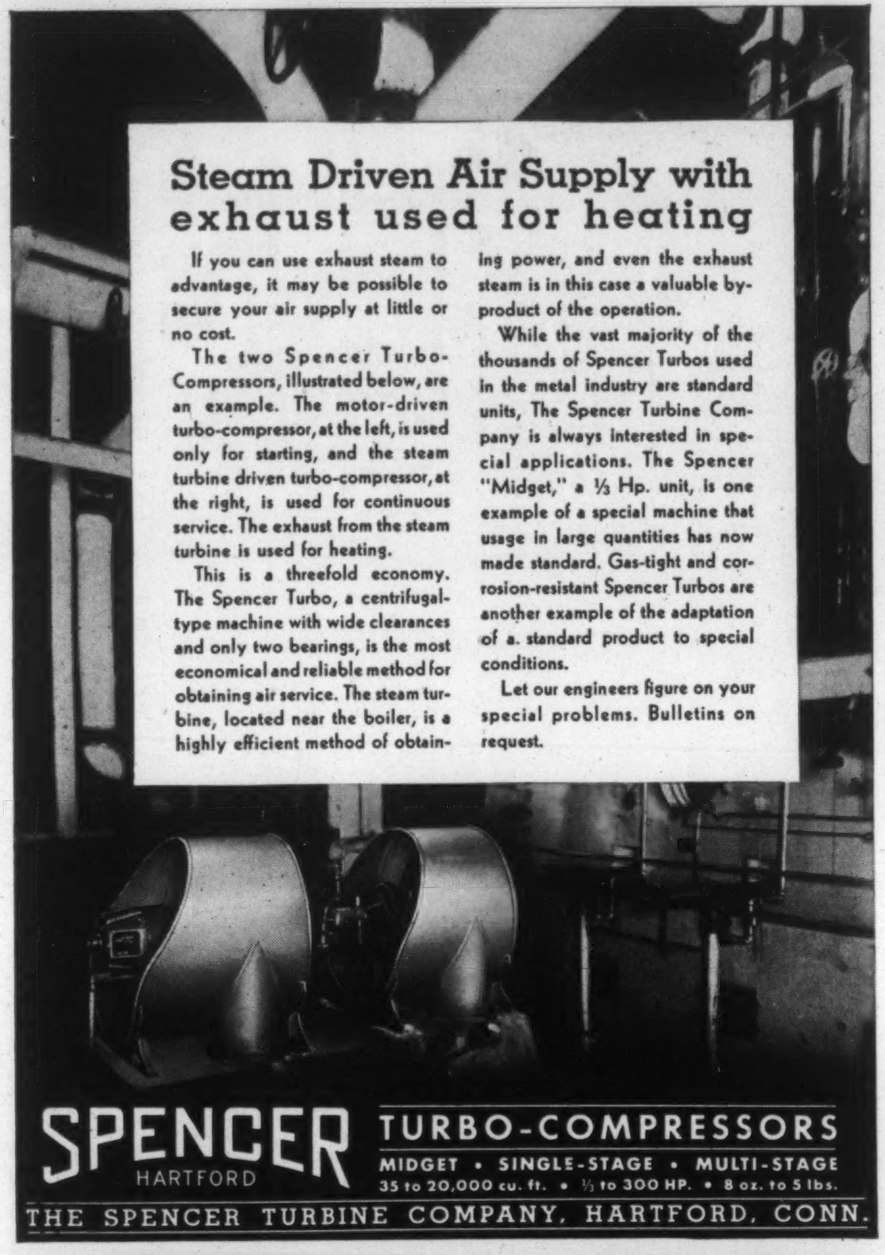
Lorenz and McKnight
Philadelphia, Pa.

Abegg and Reinhold Co., Ltd.
Los Angeles, California

The Pittsburgh Commercial Heat Treating Co., Pittsburgh, Pa.

The CHAPMAN VALVE MANUFACTURING CO.
INDIAN ORCHARD MASSACHUSETTS





Steam Driven Air Supply with exhaust used for heating

If you can use exhaust steam to advantage, it may be possible to secure your air supply at little or no cost.

The two Spencer Turbo-Compressors, illustrated below, are an example. The motor-driven turbo-compressor, at the left, is used only for starting, and the steam turbine driven turbo-compressor, at the right, is used for continuous service. The exhaust from the steam turbine is used for heating.

This is a threefold economy. The Spencer Turbo, a centrifugal-type machine with wide clearances and only two bearings, is the most economical and reliable method for obtaining air service. The steam turbine, located near the boiler, is a highly efficient method of obtaining power, and even the exhaust steam is in this case a valuable by-product of the operation.

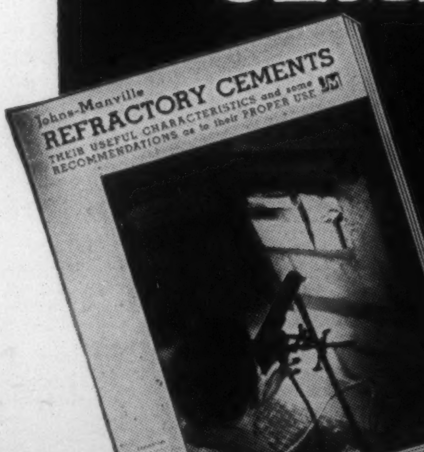
While the vast majority of the thousands of Spencer Turbos used in the metal industry are standard units, The Spencer Turbine Company is always interested in special applications. The Spencer "Midget," a ⅓ Hp. unit, is one example of a special machine that usage in large quantities has now made standard. Gas-tight and corrosion-resistant Spencer Turbos are another example of the adaptation of a. standard product to special conditions.

Let our engineers figure on your special problems. Bulletins on request.

SPENCER
HARTFORD
TURBO-COMPRESSORS
MIDGET • SINGLE-STAGE • MULTI-STAGE
35 to 20,000 cu. ft. • ½ to 300 HP. • 8 oz. to 5 lbs.
THE SPENCER TURBINE COMPANY, HARTFORD, CONN.

Minimize refractory maintenance with

Johns-Manville
REFRACTORY
CEMENTS


Johns-Manville
REFRACTORY CEMENTS
THEIR USEFUL CHARACTERISTICS and some RECOMMENDATIONS as to their PROPER USE
JM

Write for
BROCHURE
RC-6A

JOHNS-MANVILLE
JM
PRODUCTS

Johns-Manville
22 East 40th Street, New York City

(Continued from page P 50)

New Jersey Zinc Co., New York.—Booth D-21.
Exhibiting (in operation): The wide use of zinc alloy die castings in modern product manufacture. Many completely assembled articles, ranging from household equipment to industrial machinery, will be on exhibit together with their component die castings. Ranging in size from the modern automobile radiator grilles down to the chain ring bracket on a watch, these exhibits tell a startling story of the development of the use of zinc alloys. Many examples of plating, lacquering and enameling will illustrate the possibilities of finishing these articles.

Nickel & Chromium Product Co., New York.—Booth L-23.
Exhibiting (in operation): Complete installation of portable plating with demonstration.

North American Mfg. Co., Cleveland.—Booth, Gas Section and M-45.
Exhibiting (in operation): A newly developed luminous flame burner in the American Gas Association section of the show. This burner will be in operation in a scale model sheet furnace. The furnace will be arranged and constructed in such a way that the character of flame produced by the luminous burner can readily be observed. Also in operation will be a north American Gas-Air proportioning valve, controlling the luminous burner, and a turbo blower supplying air to the burner.

In booth M-45. A complete line of industrial gas burning equipment including a luminous flame burner, pressure burners, tunnel burners, venturi mixers, high pressure inspirators, gas-air proportioning valves, oil-air proportioning valves, blowers, and other smaller items of industrial gas burning equipment.

Norton Co., Worcester, Mass.—Booth Q-12 and Q-16.
Exhibiting (in operation): Alundum and crystolon general purpose grinding wheels, alundum tool grinding wheels, oilstones, mounted points, alundum and crystolon bricks and sticks, Norton diamond wheels, Norbide products, Norton refractories.

Tinius Olsen Testing Machine Co., Philadelphia—Booth B-8
Exhibiting (in operation): One 60,000 ℔ capacity universal all-hydraulic loading and weighing testing machine having three hydraulic dial indicators. One 20,000 pound capacity pendulum weighing mechanical operating machine with gear box drive, provided with our latest high magnification electric elongation recorder. Strain gauge. Verifying ring. Adjustable extensometer. Direct motor driven Brinell hardness tester. Stiffness testing machine for testing the stiffness of sheet metal and wire. Filament stiffness testing machine for light stock provided with impact test attachments. Universal impact testing machine. Balancing machine for balancing rotating parts. Our new high magnification electric recorder which will be demonstrated in connection with our 20,000-℔ capacity universal testing machine, which will be the first public demonstration of our new electronic recorder.

Ohio Crankshaft Co., Cleveland.—Booths A-5, A-9, and B-4.
Exhibiting (in operation): Tocco process of induction surface hardening crankshafts on production equipment in full operation, hardening crankshafts at the rate of 30 per hr. Full-size demonstration equipment on which the spectator may push a button and see a 2-inch bar automatically heated and quenched by the Tocco process, demonstrating the simplicity, speed and control of heating and quenching. Photomicrographs and samples of Tocco processed shafts and photographs of equipment.

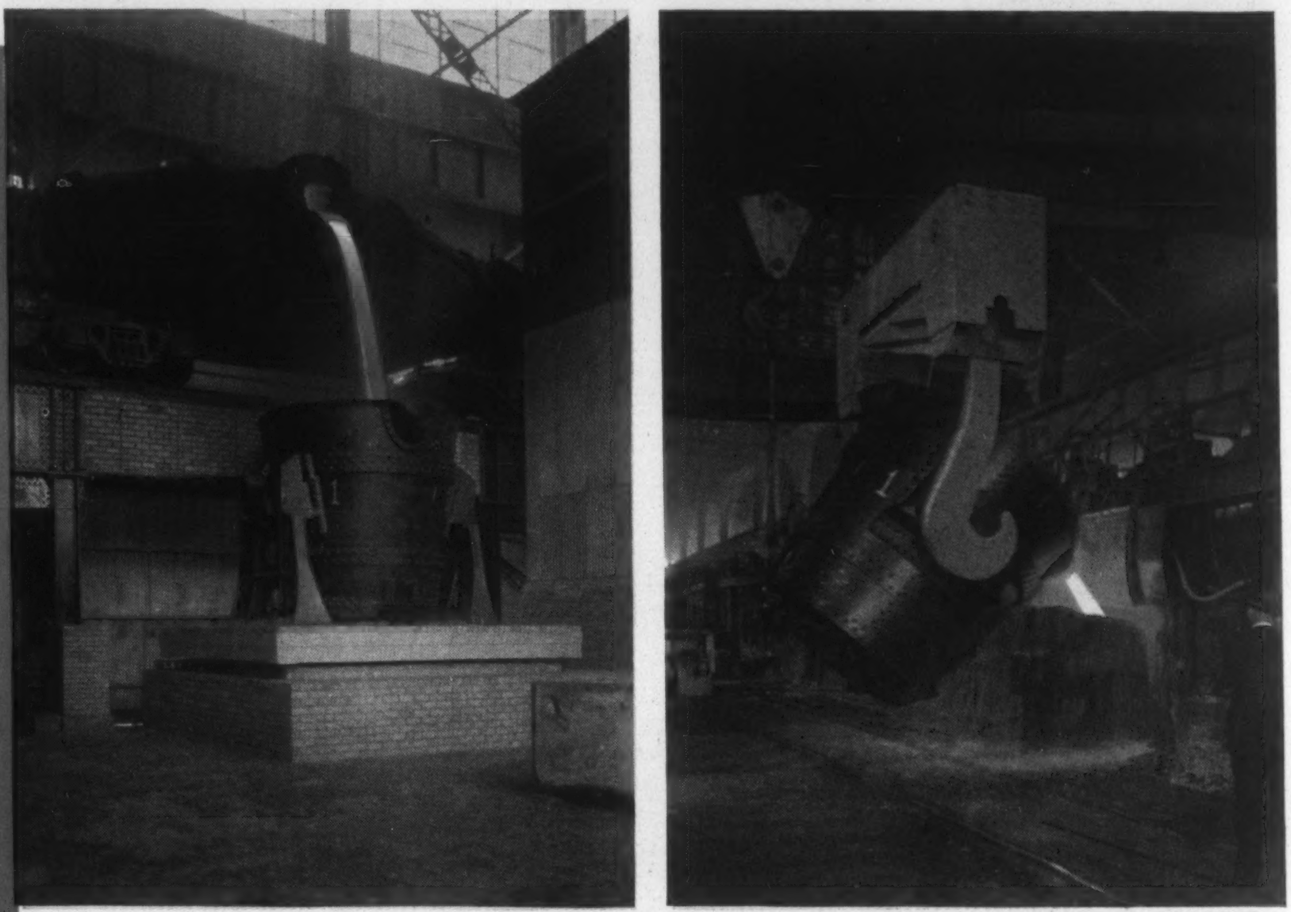
Oster Mfg. Co., Cleveland.—Booth D-2.
Exhibiting (in operation): A complete line of jigs and fixtures for the pipe welder. A torch cutting machine for pipe intersections. Portable and stationary pipe and bolt threading machines.

Page Steel & Wire Division, Bridgeport, Conn.—Booth C-23.

Pangborn Corp., Hagerstown, Md.—Booth P-27.
Exhibiting: Photographs representing complete line of Pangborn blast cleaning and dust collecting equipment, including Rotoblast centrifugal units, also some blast

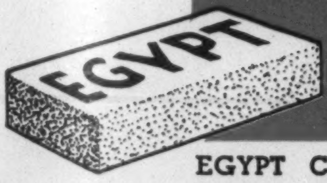
(Continued on page P 54)

Stays Put Longer★
FOR THE TOUGHEST OF JOBS

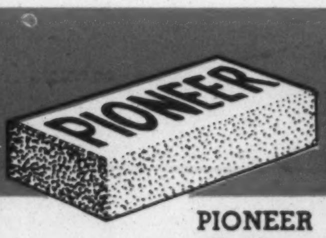


Two jobs that require the best . . . tough jobs on which Portsmouth Refractories are proving their "stuff." Molten metal is hauled from the blast furnace miles away. Then to the "mixer ladle" into the open hearth furnace.

You call a Doctor when ill . . . or an Attorney when in legal trouble. And nine chances out of ten you select such professional counsel on the basis of their experience and past accomplishments. To select "Refractories Counsel" on the same basis is just as logical. When you call on Portsmouth Refractories Engineers you gain the benefits of experience . . . technicians that have specialized exclusively in refractories for 55 years . . . products from scientifically controlled plants that under the severest tests prove their superior quality . . . and above all a research staff maintained, solely to assist users in best solving their refractories problems. Let us be your "Refractories Doctor" . . . giving you the prescription to lower refractories costs.



EGYPT CLAY BRICK for the tougher spots! A super clay brick from a scientific blend of high fusion clays. Provides greater resistance to spalling . . . higher fusion point . . . lower porosity . . . high salvage value. Furnished in either repressed, stiff mud or hand made. Everything that insures its "delivering the goods" . . . for furnaces, annealers, normalizers, slab heaters and like conditions.



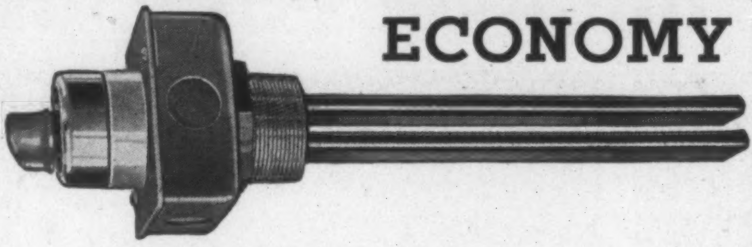
PIONEER SILICA BRICK takes a healthy slice off of your roof costs in open hearth and electric furnaces. Processed of pure quartz conglomerate and made true in size, uniformity and straightness. Users report 25% to 40% more heats per lining . . . no worries of warps or bellies . . . less spalling tendencies when subject to rapid temperature changes. It does the job intended better! That explains the increasing demand for PIONEER.

★ *Users say 25% to 40% more heats with PORTSMOUTH REFRACTORIES*

The PORTSMOUTH REFRACTORIES Co.

GENERAL OFFICES **PORTSMOUTH, OHIO**

KANTHAL'S "DOUBLE HEADER" ECONOMY



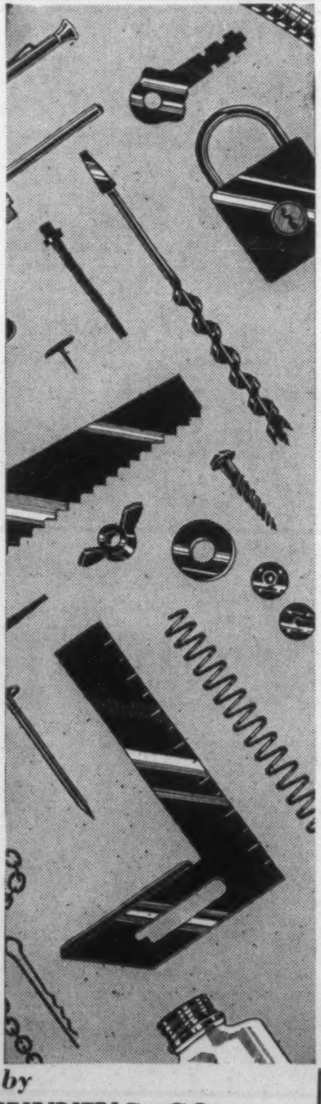
MORE compact units are possible because less material is needed when Kanthal is used. Required heat is attained with less bulk because of Kanthal's higher electrical resistivity.

Kanthal D will produce more units per pound because its specific gravity is 15% lower than that of nickel chromium which is more commonly used. Its electrical resistance is 24% higher.

The
C. O. Jelliff Mfg. Corp.
Southport, Conn.
JELLIFF EXHIBIT — BOOTH N-11

the JETAL process *a simple way to*

BLACKEN
Iron and Steel



THE Jetal process colors iron and steel products at low temperature, by immersion, to a uniform and brilliant black. It is a complete finish in itself and will not chip, scale, peel or discolor. It replaces more involved and expensive black finishes and forms an excellent bond for subsequent finishes such as japan, lacquers, varnishes, enamels, etc., that require high temperatures.

Ask for descriptive circular and send samples to be JETALized.

ALROSE CHEMICAL COMPANY
Executive Offices—80 Clifford St.
PROVIDENCE, R. I.

Also Distributed by
HANSON-VAN WINKLE-MUNNING CO.
MATAWAN, NEW JERSEY

(Continued from page P 52)

cleaning units on display. Complete line of blast cleaning accessories including hose, helmets and "certified" steel abrasives.

Park Chemical Co., Detroit—Booth M-11.
Exhibiting: A display of hardening and heat treating materials, liquid carburizers, buffing and polishing materials.

Parker-Kalon Corp., New York.—Booth I-26.
Exhibiting (in operation): Complete line hardened self-tapping screws. hardened masonry nails and screwnails and the cold-forged line including wing nuts, cap nuts and thumb screws. Demonstrations will be made and tests conducted on the holding power of these products versus devices they intend to replace under tension and shear stresses; specially designed testing equipment being used for this purpose.

There will also be exhibited for the first time a product of the Parker-Kalon laboratory known as the micro-comporator—a device for measuring by mechanical means variations in planed surfaces of one-ten millionth of an inch. Likewise, Parker-Kalon gauge blocks, another product of the laboratory, will be shown.

Partlow Corp., New Hartford, N. Y.—Booth, Gas Section.
Exhibiting (in operation): Temperature controls, for both gas and electric, limit controls, dial thermometers. safety gas valves, safety pilots.

These safety pilots are something entirely new. In case of gas failure, pilot failure or electric failure, the entire gas supply will be shut off instantly. A very simple mechanism using no delicate parts.

Henry Pels & Co., New York—Booth Q-24.

Philadelphia Drying Machinery Co., Philadelphia—Booth M-46.
Exhibiting: Photographs of new developments in furnaces for various heating applications, including annealing, carburizing, forging, hardening. tempering, melting, calcining, frit smelting, also core baking, convection annealing, glass annealing, direct and indirect fired. Complete display of oil burers, ranging in size from ½ to 4-in with oil capacities from 1-10 gal. per hour to 55 gals. per hour, also three types of gas burners, of the proportional mixing type, low pressure velocity type and atmospheric type.

Pittsburgh Instrument & Machine Co., Pittsburgh.—Booth G-34.
Exhibiting (in operation): Diamo-Brinell testing machine with diamond indenter, power-operated Brinell machine, hand-operated Brinell machine, Brinell microscopes, direct-reading Brinell instrument, depth indicator for Brinell tests, Brinell calibrator for checking Brinell machines.

Product Engineering, New York.—Booth N-53.

Production Machine Co., Greenfield. Mass.—Booth Q-23.
Exhibiting (in operation): Production type No. 101 patent centerless belt feed polishing, finishing and buffing machine for tube, rod, and bar work. Type "S" production centerless polishing and finishing machine. Production type No. 1 9" vertical machine. Production type No. 6 9" horizontal machine. Production type No. 601 4" bench handy speed finisher. Production type No. 606 6" bench surfacer.

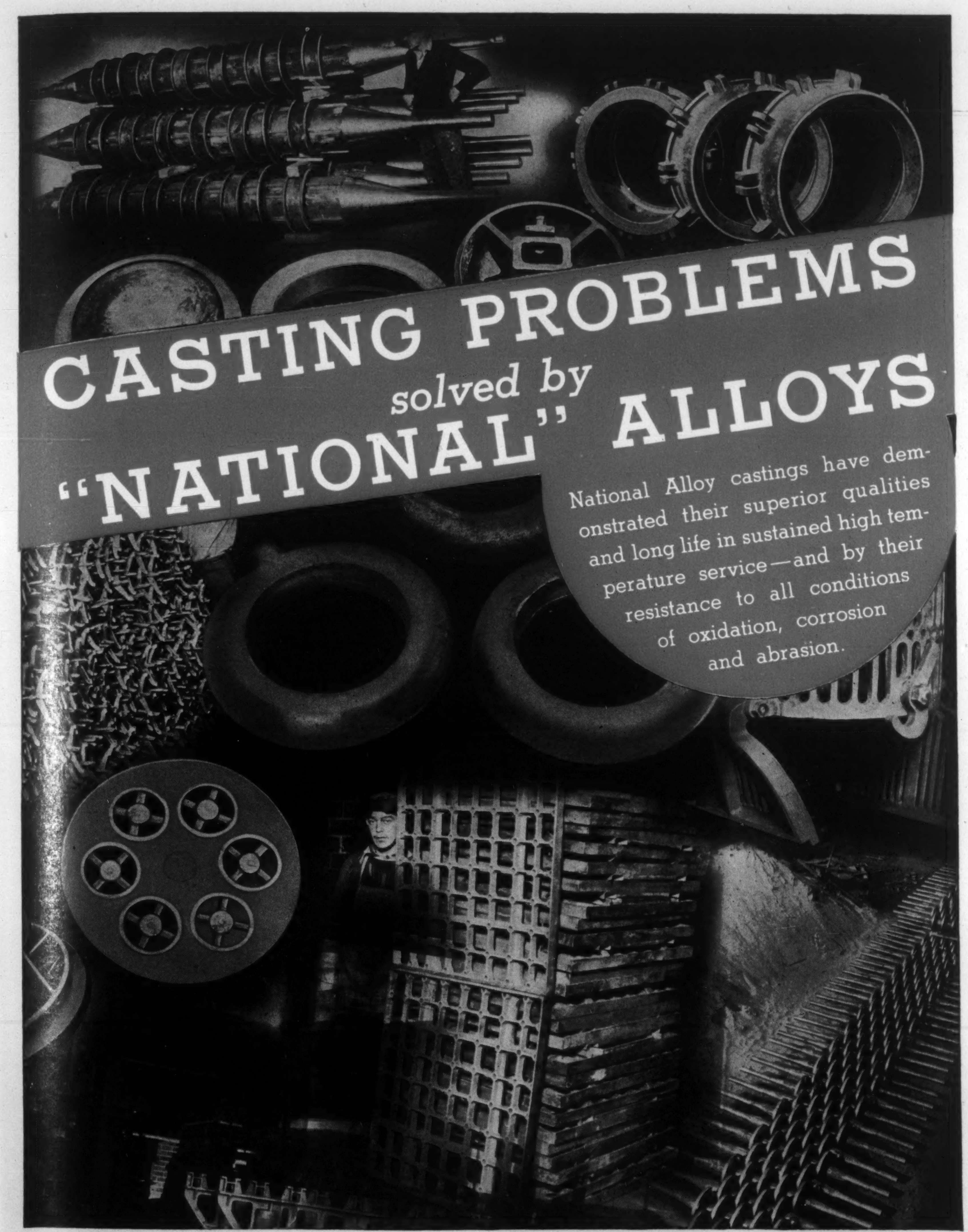
Pyrometer Service & Supply Corp., Cleveland.—Booth B-18.
Exhibiting: A display emphasizing our facilities as high temperature engineers, including such accessories as thermocouples, protecting tubes, insulators, lead wire, Gordon therocouple heads, and samples of repaired instruments.

Quigley Co.. Inc., New York.—Booth L-37.

Republic Steel Corp., Cleveland.—Booth E-6.

John A. Roebling's Sons Co., Trenton, N. J.—Booth O-12.
Exhibiting: Wire rope and miscellaneous round and flat wire.

(Continued on page P 56)



CASTING PROBLEMS
solved by
"NATIONAL" ALLOYS

National Alloy castings have demonstrated their superior qualities and long life in sustained high temperature service—and by their resistance to all conditions of oxidation, corrosion and abrasion.

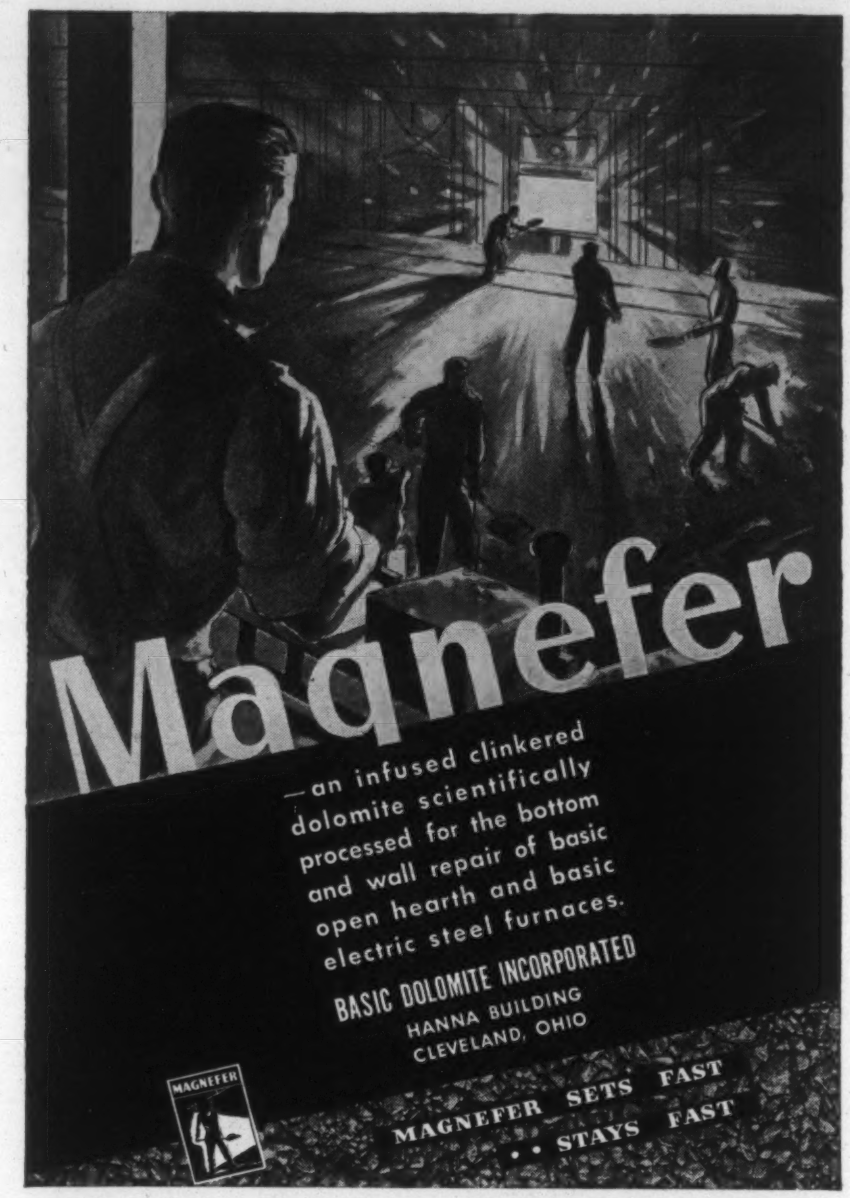
NATIONAL ALLOY STEEL CO.

BLAWKNOX, PA.

Branches and Distributors

New York · Detroit · Pittsburgh · Chicago · Birmingham · Horace T. Potts Co., Philadelphia, Pa.

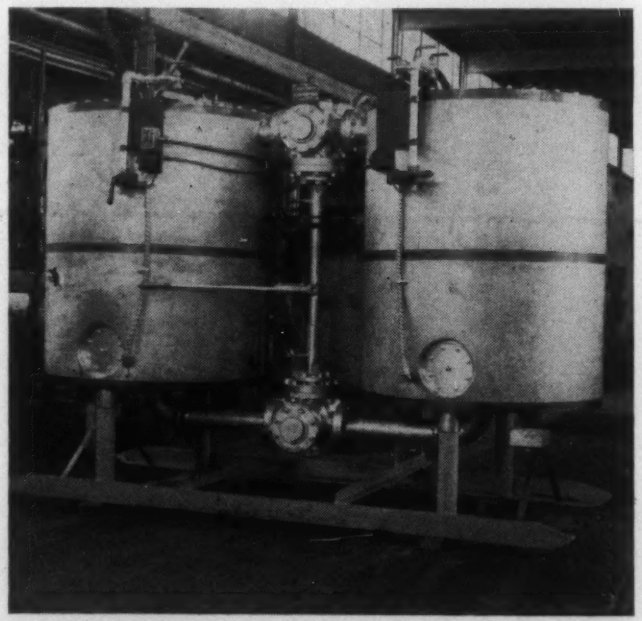
NA


Magnefer
—an infused clinkered dolomite scientifically processed for the bottom and wall repair of basic open hearth and basic electric steel furnaces.
BASIC DOLOMITE INCORPORATED
HANNA BUILDING
CLEVELAND, OHIO
MAGNEFER
MAGNEFER SETS FAST
• • STAYS FAST

THIS MODERN MACHINE DRIES AIR AND GASES

without the use of messy or corrosive chemicals—or moving parts

DEW POINTS TO BELOW—60°C



For controlled atmosphere annealing — special process rooms—gas conditioning, the LECTRODRYER "Activated Alumina System."

PITTSBURGH LECTRODRYER CORP.

Foot of 32nd Street, Pittsburgh, Pa.

(Continued from page P 54)

Rustless Iron & Steel Corp., Baltimore.—Booth L-43.
Exhibiting: Rustless or stainless ingots, billets, bars, rods and wire in various commercial forms. Finished articles and machined parts fabricated from rustless or stainless bars, rods and wire.

Joseph T. Ryerson & Son., Inc., Chicago.—Booth I-22.
Exhibiting: Steel and allied products.

Safety Gas Lighter Co., Lynn, Mass.—Booth I-33.
Exhibiting (in operation): Improved round file gas lighters (for welders' use and household appliances)—gas ranges, hot water heaters, etc. "Popular" and "Pyro" hand gas lighters. Stationary ignition equipment for all types gas installations. Regulator clamps for laboratory and surgical equipment. Exhibit showing origin and development of gas lighters from inception in 1901 to present day.

Salem Engineering Co., Salem, Ohio.—Booth M 10.
Exhibiting: Photographs and illustrations of modern furnace design.

George Scherr Co., Inc., New York.—Booth D-26.

Scully Steel Products Co., Chicago. (United States Steel Corp. Subsidiary). Booth C-15.
Exhibiting: See "United States Steel Corp. Subsidiaries."

Selas Co., Philadelphia.—Booth Gas Section.

Sentry Co., Foxboro. Mass.—Booth O-25.
Exhibiting (in operation): The new model "Y" electric high speed steel hardening furnace, which by eliminating water cooling and complicated atmosphere control systems offers economy and efficiency giving uniform, controlled hardening temperatures and heats to 2350° F. in less than an hour.

Constant, correct furnace atmosphere is maintained by the Sentry diamond block method of atmospheric control, assuring tools of maximum hardness and toughness free from scale, decarburization, or reduction in size on all high speed steels. Even the sharpest cutting edges and corners are retained during hardening. Many sizes of Sentry diamond blocks will be on display.

Also showing the Sentry high temperature (2550°F.) tube furnace offering greater speed and precision for combustion analysis of stainless and other steels. The furnace and teminals are of rugged construction giving an average of more than five years' service. Highly efficient and economical to operate.

Spencer Turbine Co., Hartford, Conn.—Booth N-34.
Exhibiting (in operation): Centrifugal type Turbo compressors used for operating gas and oil-fired furnaces and industrial type vacuum cleaning. A slow speed multi-stage centrifugal type Turbo compressor supplying air for the gas furnaces operating during the exhibit. Smallest size "Midget" and also machine made up with special metal for use in handling corrosive acid fumes. The industrial type vacuum cleaner operating to show the effectiveness of cleaning in industrial plants, and handling large accumulations of litter.

Steel, Cleveland.—Booth Q-4.

Steel City Testing Laboratory, Detroit.—Booth M-5.

Stoody Co., Whittier, Calif.—Booth N-8.
Exhibiting (in operation): Motion picture.

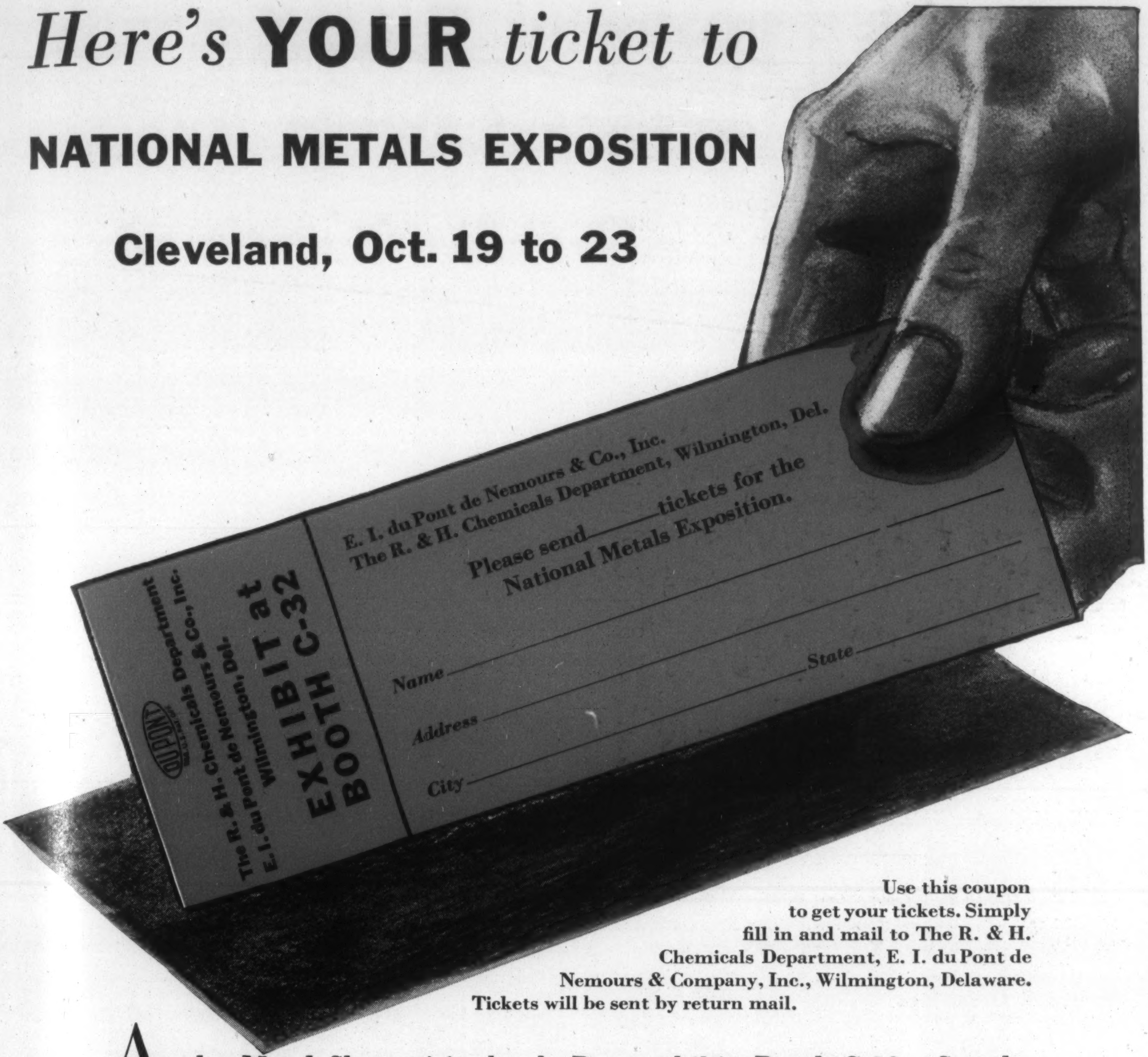
D. A. Stuart Oil Co., Chicago.—Booth L-25.
Exhibiting (in operation): A full line of carefully manufactured "Extreme Pressure" (EP) industrial oils and greases, and will demonstrate the difference between EP and non-EP lubricants to visitors interested in the subject by means of one or more of the better known EP lubricant testing machines. In addition, "Third-Kut" oil as recommended by practically all machine tool builders as a modern tool lubricant for production, tool room, or plant maintenance requirements; Stuart's "Codol" liquid grinding compound, a comparatively new development in soluble grinding and cutting oil; Stuart's "Super-Kool" drawing lubricants (for stainless steel);

(Continued on page P 58)

Here's **YOUR** *ticket to*

NATIONAL METALS EXPOSITION

Cleveland, Oct. 19 to 23



The R. & H. Chemicals Department
E. I. du Pont de Nemours & Co., Inc.
Wilmington, Del.

EXHIBIT at
BOOTH C-32

E. I. du Pont de Nemours & Co., Inc.
The R. & H. Chemicals Department, Wilmington, Del.

Please send______tickets for the
National Metals Exposition.

Name____________________
Address____________________
City____________________ State__________

Use this coupon to get your tickets. Simply fill in and mail to The R. & H. Chemicals Department, E. I. du Pont de Nemours & Company, Inc., Wilmington, Delaware. Tickets will be sent by return mail.

At the Metal Show visit the du Pont exhibit, Booth C-32. See the first public demonstration of the new barrel-plating solution for Bright Zinc—a practical, economical process which has been in successful use for several months in a number of job and commercial plating shops.

Du Pont technical men, metallurgists, electroplaters, will be on hand for consultation about heat-treatment of steels, preparation of metal surfaces and electroplating of metal parts.

DU PONT
REG. U. S. PAT. OFF.

E. I. du Pont de Nemours & Company, Inc., The R. & H. Chemicals Department

R & H CHEMICALS AND PROCESSES

For Modern Metal Finishing

Specify DURALOY Centrifugal Castings which are made in an up-to-date, well-equipped foundry by those who pioneered in the production of these better castings and who have the necessary skill to turn out sound castings.

Centrifugal Castings are superior castings in that the metal is denser and more uniform. The strength is higher. The metal is free from blowholes and gas pockets. Tubing is exceptionally straight and true.

Almost any shape can be cast centrifugally providing it is permissible to have a uniform hole through the center. They can be cast of any Chrome-Iron, Chrome-Nickel or Nickel-Chrome Alloy.

Duraloy Metallurgists will be glad to assist in the design and the production of centrifugal castings to meet your requirements.

THE DURALOY COMPANY
General Office: PITTSBURGH
NEW YORK • CLEVELAND • CHICAGO • PLANT, NEW CUMBERLAND, W. VA.

(Continued from page P 56)

as well as sample parts machined with these well-known lubricants.

Surface Combustion Corp., Toledo.—Booth, Gas Section.
Exhibiting (in operation): SC gas-fired radiant tubes with glass inserted so that the public can see the interior very easily. Also an SC high speed furnace and and SC air heater. Tables and display easels showing samples of various metal products which have been heat treated with SC equipment.

Syncro Machine Co., Newark, N. J.—Booth N-1.

C. J. Tagliabue Mfg. Co., Brooklyn, N. Y.—Booth M-15.
Exhibiting (in operation): The complete line of Tag photoelectrically balanced potentiometer pyrometers, featuring simplification of design and several new models and improved details of construction will be exhibited,—for example, a new pen with ink capacity enabling it to write a record line one mile long. A display of the latest developments in modern pressure spring instrumentation. These rectangular case instruments, with many new and convenient refinements, indicate, record and control temperature and pressure. Their advanced mechanical construction embodies such improvements as the interchangeable calibrated tube system; over-range protection provided by safety linkage between Bourdon spring and pen movement; visible record pen arm; new stainless steel hub; and a full size 12-inch chart with 5¼ inch pen travel—the very largest chart available.

Magnetic clutch flow instruments will also be displayed.

In addition Tag industrial thermometers, Tag chemical thermometers, Tag hydrometers and oil testing instruments will be prominently shown.

Tennessee Coal, Iron and Railroad Co., Birmingham, Ala., (United States Steel Corp. Subsidiaries).—Booth C-15.
Exhibiting: See "United States Steel Corp. Subsidiaries."

The Timken Steel & Tube Co., Canton, Ohio.—Booth F-33.
Exhibiting: Illustrations of Timken manufacturing processes and samples of various types of Timken steels and tubing.

Titanium Alloy Mfg. Co., Niagara Falls. N. Y.—Booth M-50.
Exhibiting: Examples of titanium treated steels, cast iron, aluminum, etc.

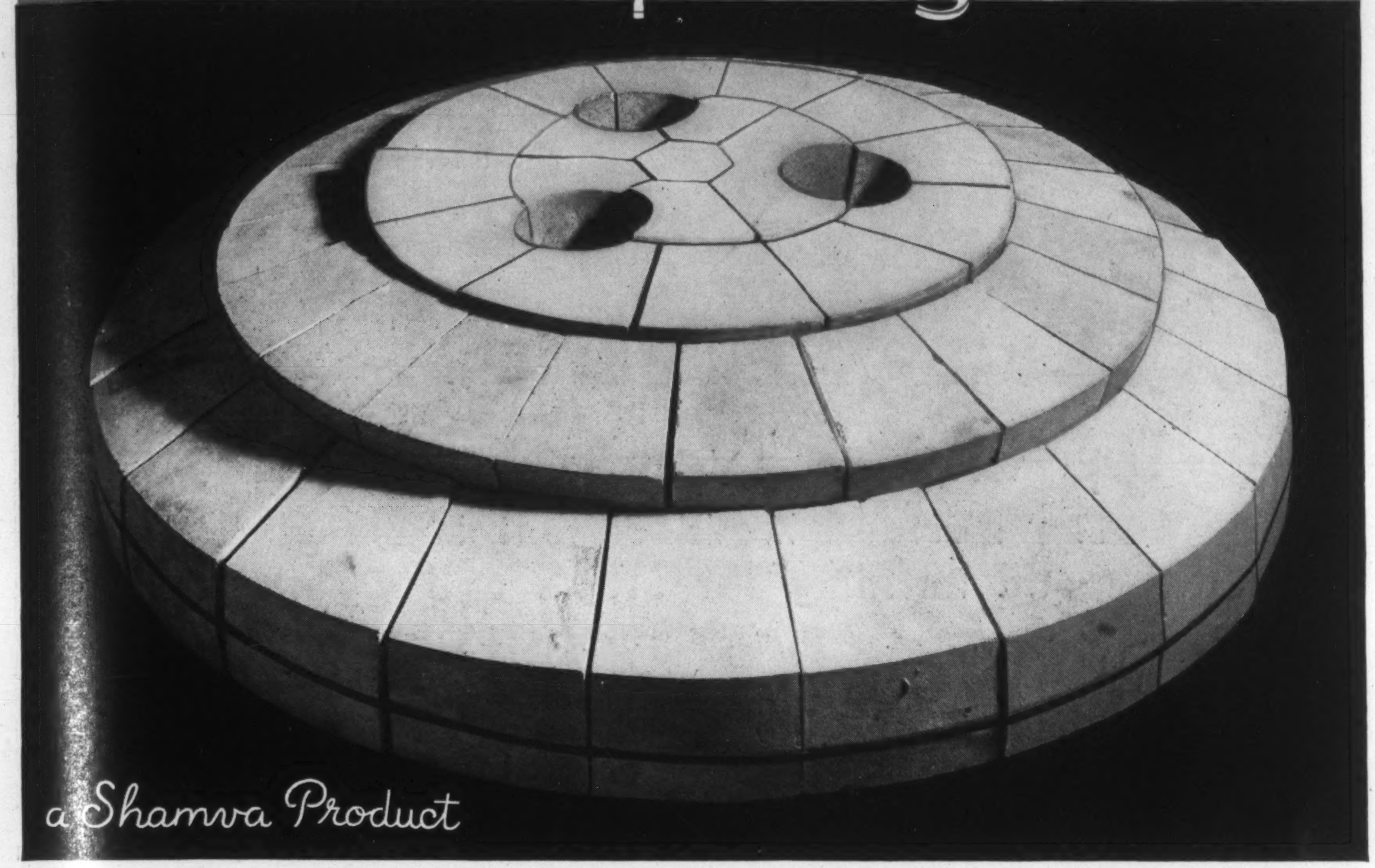
Una Welding, Inc., Cleveland.—Booth H-23
Exhibiting (in operation): A full automatic Una electric arc welding head and Una-taper demonstrating a practical method of automatic welding with complete protection of weld metal. The necessary quantity of coating to give protected arc quality metal being supplied by a combination of coating on the rod and on tape which is wrapped around the rod by the Una-taper as the rod approaches the arc. Practical demonstrations using the 36 Una rods of all types including a complete line of protected arc rods, high speed production rods, rods for maintenance use and general purpose rods. Una welders for automatic and manual welding.

Union Carbide Co., New York.—Booth O-30.

United States Steel Corp., Subsidiaries, Pittsburgh.—Booth C-15.
Exhibiting: A rounded out display of progress in steel making, featuring alloy steels, now being marketed under the new trade name "USS Carilloy" together with the well-known USS high tensile steels including USS stainless steels. No detailed information has yet been released on the manner of presentation of these products, but it is certain that the display will be outstandingly attractive and informative to convention visitors. Light, color, and motion, together with a number of surprise features will dramatize the display of United States Steel.

(Continued on page P 60)

an End *to* Spalling Roofs!



. . . . . . AND FROM 3 TO 5 TIMES THE USUAL NUMBER OF HEATS

A "Shamva" Mullite roof for your electric or O. H. furnace may cost more than one of silica or fire clay, but it will deliver 3 to 5 times the heats; and contamination of the bath from falling refractory particles is practically eliminated.

"Shamva" Mullite is ideal for roofs, arches, piers, and overhead work. Its low co-efficient of expansion enables it to undergo rapid heating and cooling without spalling, and its interlocking crystal structure and high softening point (3300° F). give it remarkable load-bearing capacity.

The "Shamva" Book explains all these points in detail. May we send you a copy free?

WRITE FOR FREE SHAMVA BOOK

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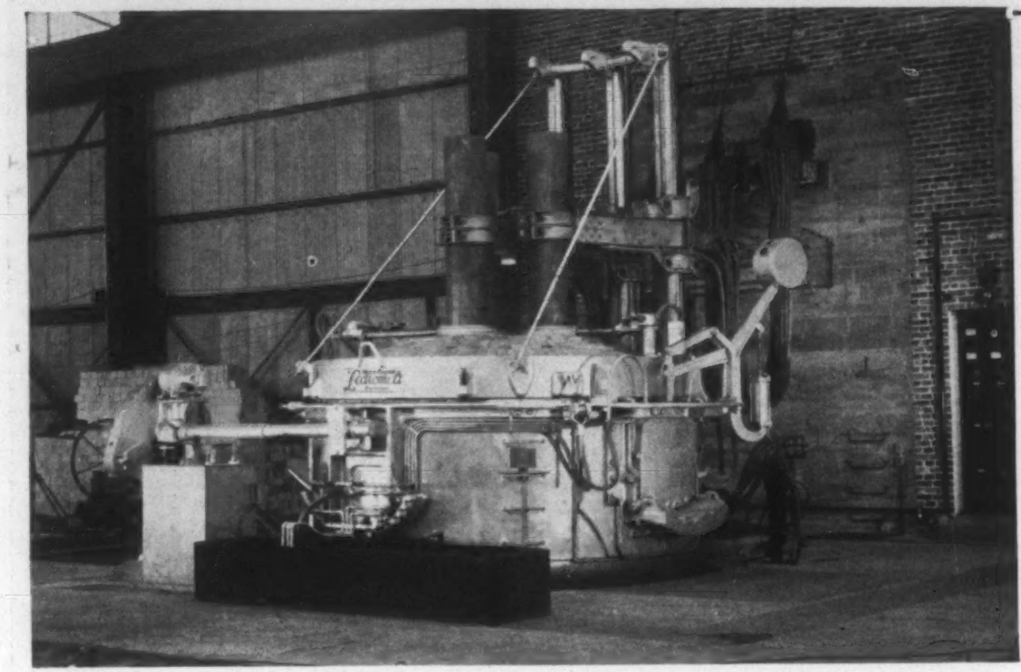
SHAPES
BRICKS
CEMENTS

MULLITE

THE 3300° SUPER-REFRACTORY

FOR ALL
TYPES OF
FURNACES

EXHIBITING AT NATIONAL METAL EXPOSITION CLEVELAND, OCTOBER 19-23



LECTROMELT . . .
MODERN STEEL WORKS and FOUNDRY
ARC FURNACES

Illustrated is one of three 10-ton basic swing-roof top-charge type Lectromelt Furnaces recently installed in Mid-West rolling mills for the manufacture of billet size ingots.

The Top Charge Type Lectromelt Furnace
The Decided Advancement in Electric
Melting and Refining for Steels and Quality Irons
Bulletin TC Describes the Top-Charge Type Furnace
PITTSBURGH LECTROMELT FURNACE CORP.
Foot of 32nd Street, Pittsburgh, Pa., P.O. Box 1257
Electric Melting, Refining and Smelting Furnaces—Standard Sizes 25 lb. to 50 tons.

(Continued from page P 58)

Universal Steel Co., Bridgeville, Pa.—Booth G-32.
Exhibiting: All types of high-grade tool steels, stainless steels, and specialty steels.

Vanadium-Alloys Steel Co., Latrobe. Pa.—Booth Q-28.
Exhibiting (in operation): Tantalum carbide tipped tools, drawing dies, sizing dies, and the products fabricated by them. Photographs and reports of actual results with "Vascoloy-Ramet" tools and dies will be available with verbal description by Vascoloy-Ramet sales representatives. We hope to use this opportunity to renew acquaintances in the metal fabricating industry and discuss the way in which the problems of production have been solved with Vascoloy-Ramet, the tantalum carbide tool material.

Vanadium Corp. of America, New York.—Booth G-2.

Victor Saw Works, Inc., Middletown, N. Y.—Booth F-2.

Weldit Acetylene, Detroit.—Booth M-16.

Welding Engineer Publishing Co., Chicago.—Booth M-49.
Exhibiting: Literature available to those interested in welding fabrication, maintenance and repair.

Wells Mfg. Corp., Three Rivers, Mich.—Booth I-2.
Exhibiting (in operation): Wells metal cutting band saws; No. 8 capacity—8 in. diameter, 8 in x 16 in. flat; No. 5 capacity—5 in. diameter 5 in. x 10 in. flat, horizontal band saws; direct driven and portable; simple in construction and operation; rapid and accurate cutting; gravity feed; no coolant; and automatic stop.

Wheelco Instruments Co., Chicago.—Booth I-32.
Exhibiting (in operation): Production samples of all of our standard instruments. An enlarged working model demonstrating the "No Contact Principle of Control." A working model demonstrating the "Flame-otrol" showing the electrical conductivity of an ordinary gas flame. A working model of a water level control employing the no contact principle. A Wheelco no contact temperature control actually controlling a small furnace—showing a record of the control curve.

Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.—Booth H-21.
Exhibiting: Examples of parts manufactured from "Hy-Ten" and S.A.E. alloy steels.

Williams & Co., Inc., Cleveland.—Booth O-39.
Exhibiting (in operation): Nickel, aluminum, brass and copper welding electrodes, welding machines, boiler tubes and head and eye protection. In addition, there will be an operating demonstration of arc welding of our many types of welding rod for special purposes.

Wilson Mechanical Instrument Co., Inc., New York.—Booth C-25.
Exhibiting (in operation): "Rockwell" hardness tester. "Rockwell" superficial hardness tester. "Rockwell" hardness tester, with gooseneck for testing inner surfaces of tubes or rings. Work support accessories, spares and renewals for "Rockwell" tester.

Wilson Welder & Metals, Inc., North Bergen, N. J.—Booth G-7.

Wire Association, New York.—Booth N-3.

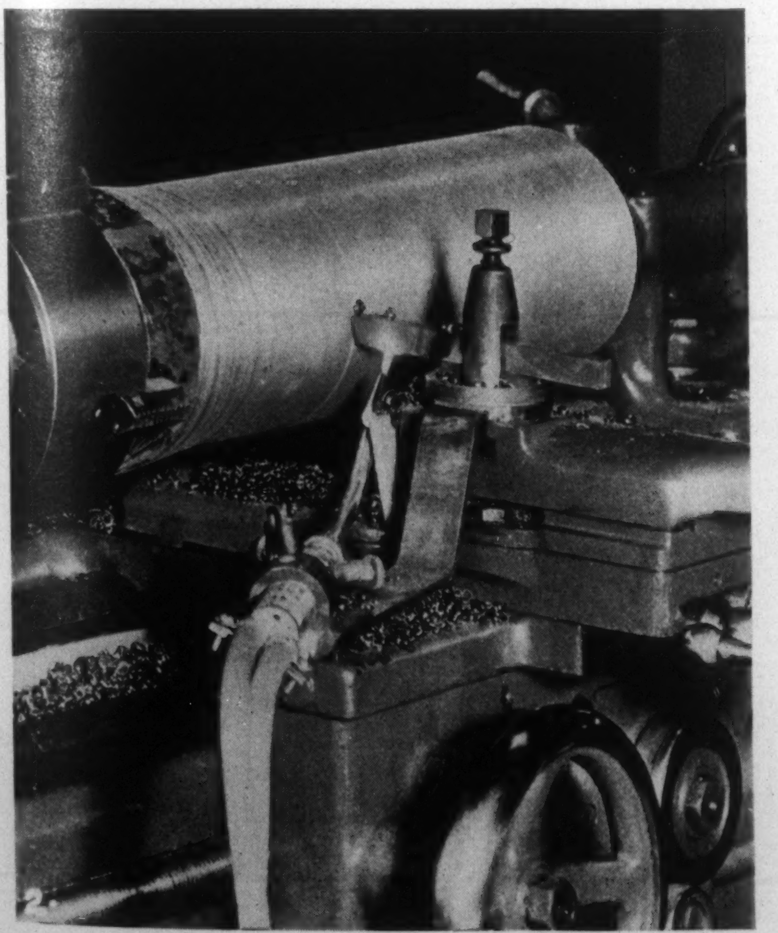
Youngstown Sheet & Tube Co., Youngstown, Ohio.—Booth E-24.

Carl Zeiss, Inc., New York.—Booth C-33.
Exhibiting (in operation): Microscopes and accessories for the examination of metals and photomicrographic apparatus for routine work as well as for the most exacting research laboratory. Particular attention is called to the "Neophot" and "Metalliput" metallographs, both equipped for light field, dark ground and polarized light, requiring no special adjustment. For spectrum analysis of all kinds of material we are showing for the first time in this country our new "Spectrograph Qu 24," the latest development in spectrum cameras, requiring no adjustments whatsoever.

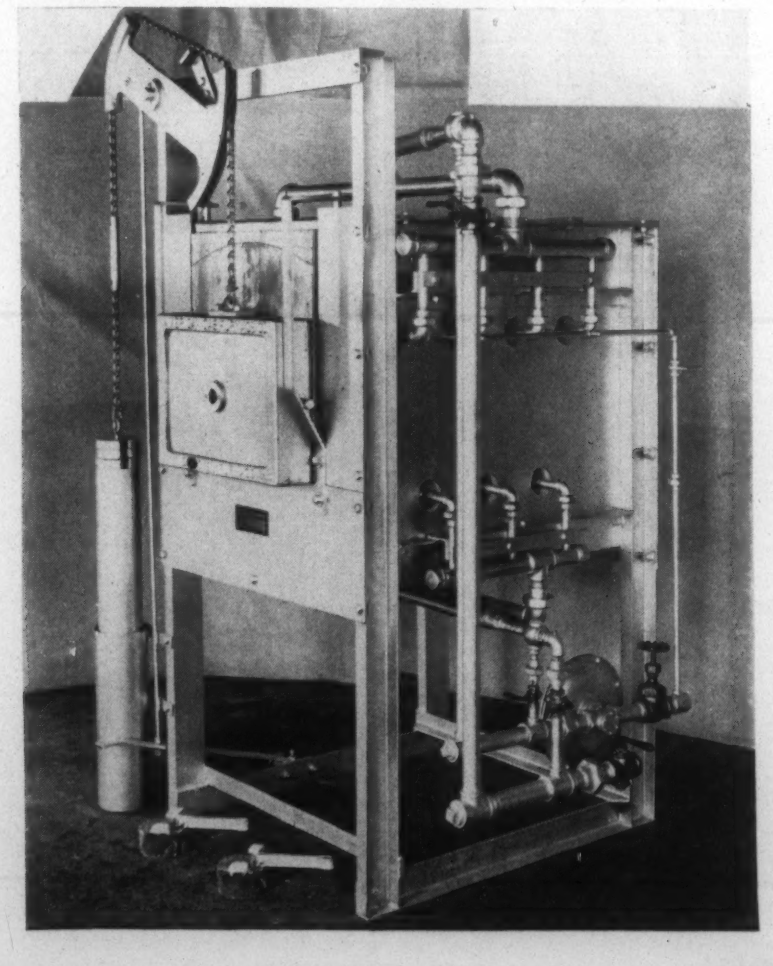
Some of the Developments and Exhibits in the Metal Industry

ON this and the following seven pages there are displayed illustrations of some of the special equipment and products which will be exhibited at the National Metal Exposition, as well as a few special developments which are of interest but not exhibited. This presentation is by no means intended to be comprehensive.

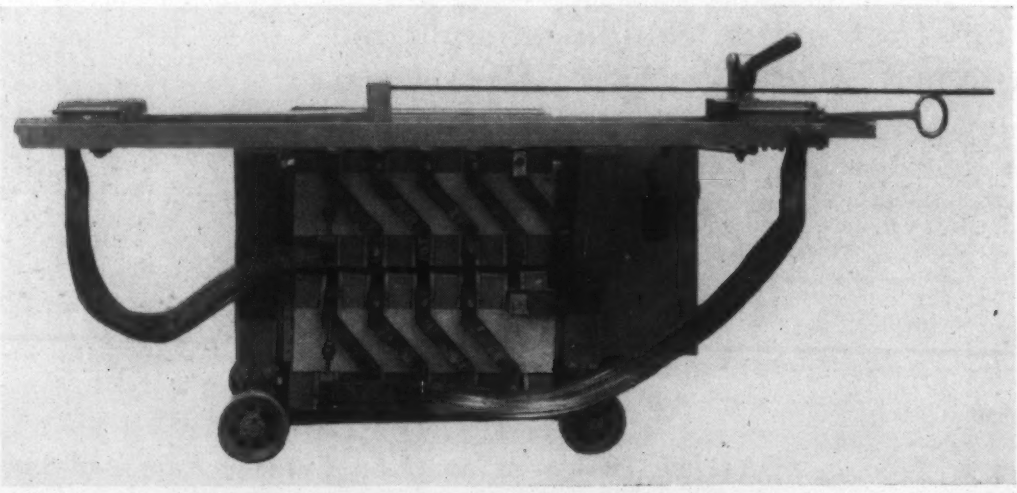
A Haynes Stellite "J-Metal" Cutting Tool Turning a Steel Billet While the Tool is Held at a Red Heat by an Oxyacetylene Torch.



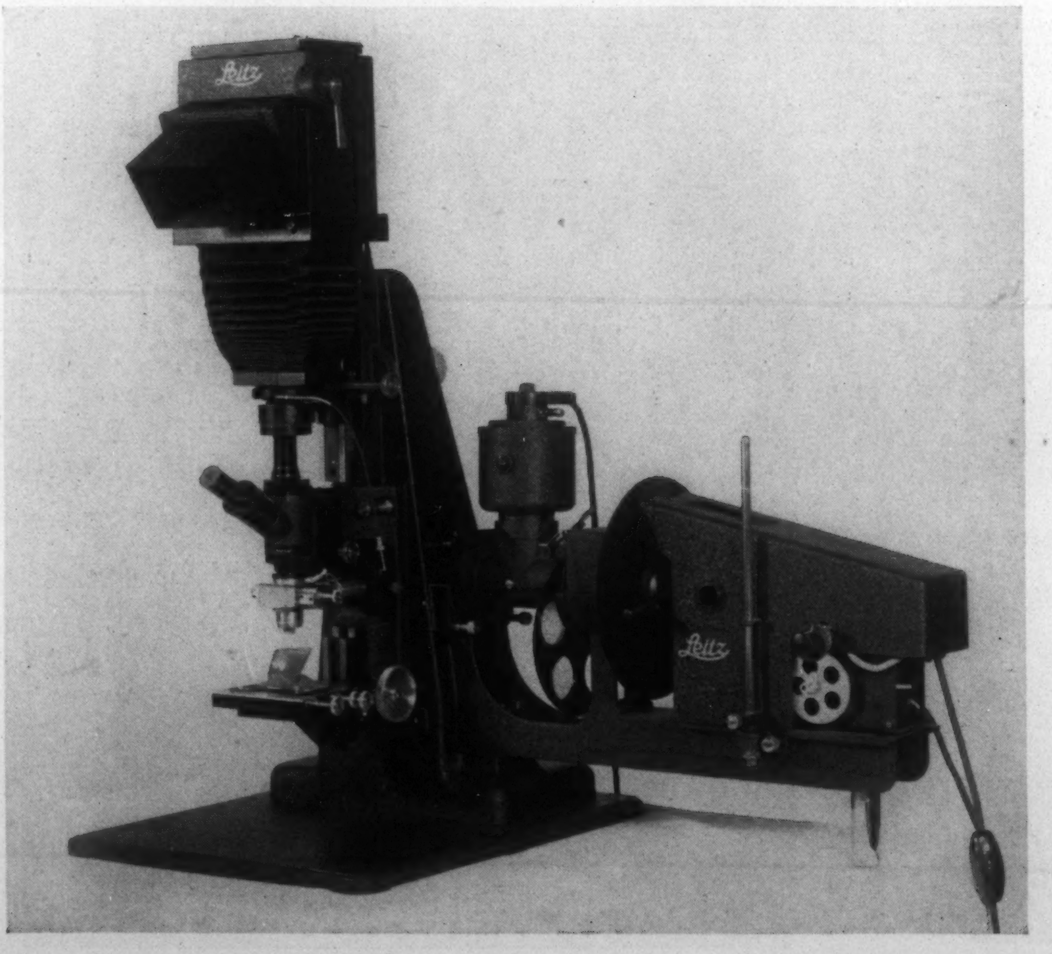
A New Design of an Oven Furnace Exhibited for the First Time by the American Gas Furnace Co., Elizabeth, N. J.



Demonstrating at the Exposition the Advantages of Columbian Treated Stainless Steel Welding Rod.

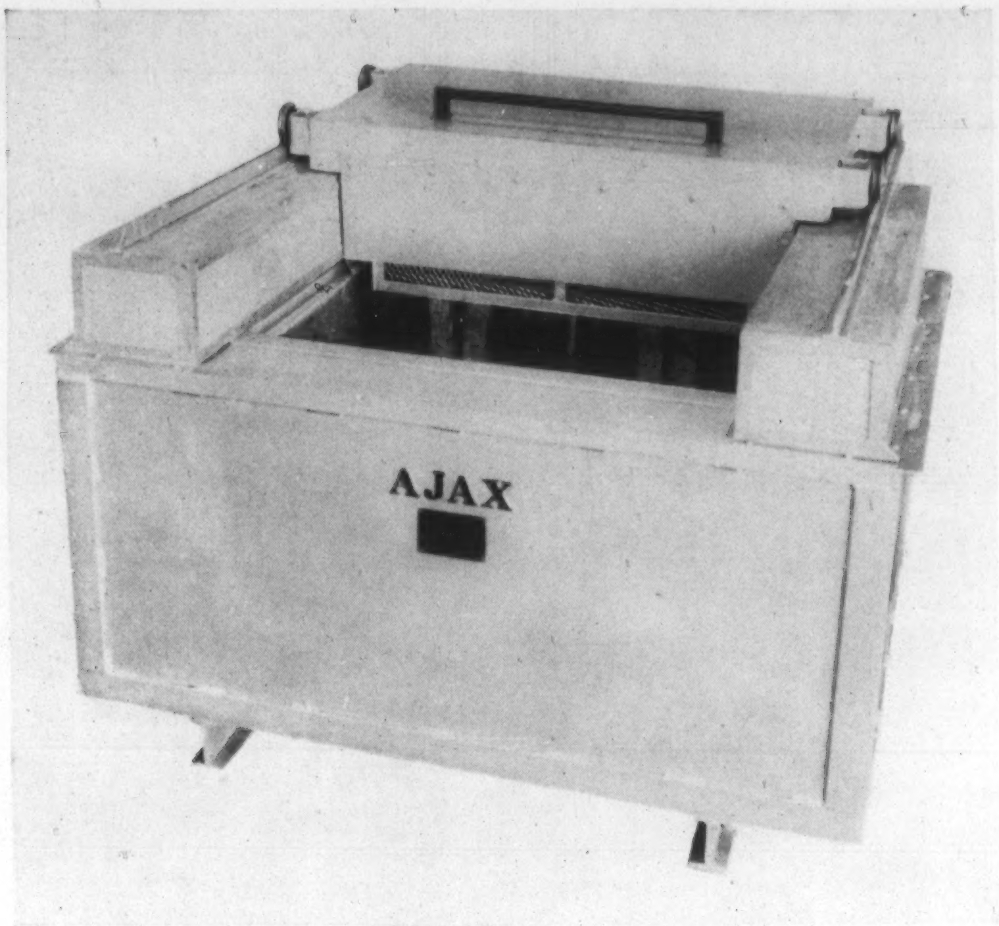


A Berwick Electric Six-Foot Ba Heater of the American Car & Foundr Co., New York.

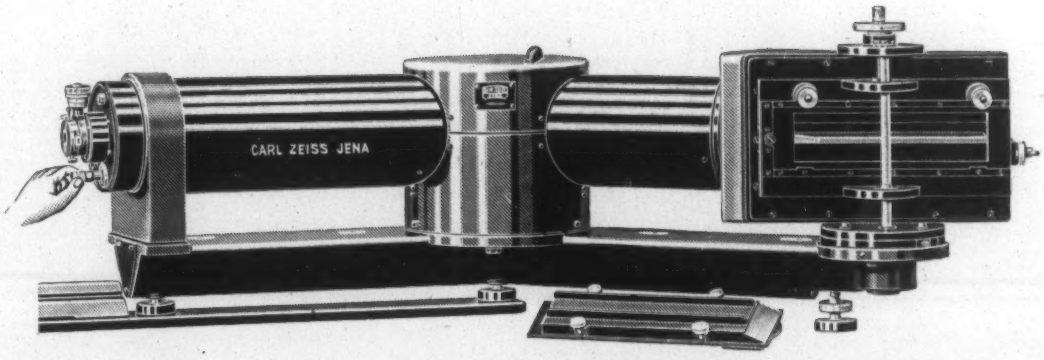


The Panphot Equipment with the Panopak Illuminator of E. Leitz, Inc., New York, Exhibited for the First Time.

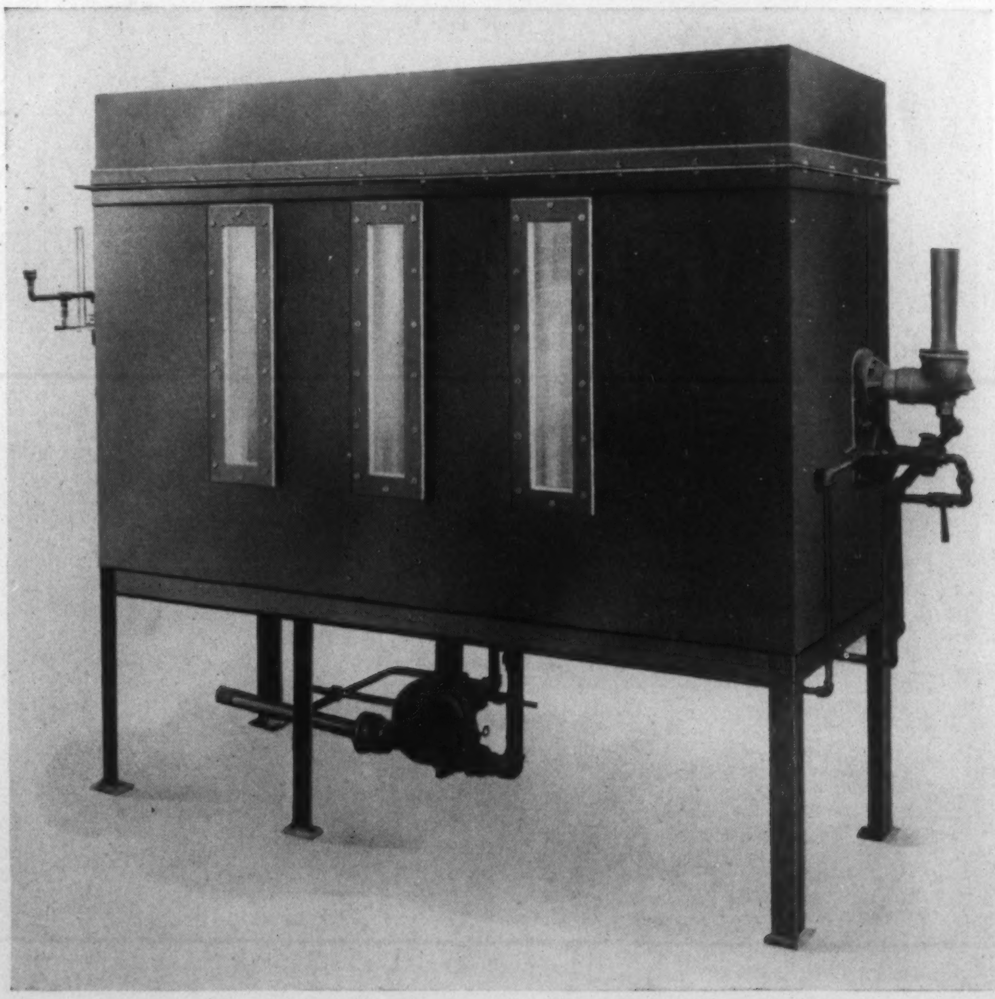
The New Ajax-Hultgren Salt Bath Furnace of the Ajax Electric Co., Philadelphia. A full description of this furnace was published in METALS AND ALLOYS in June, 1936.

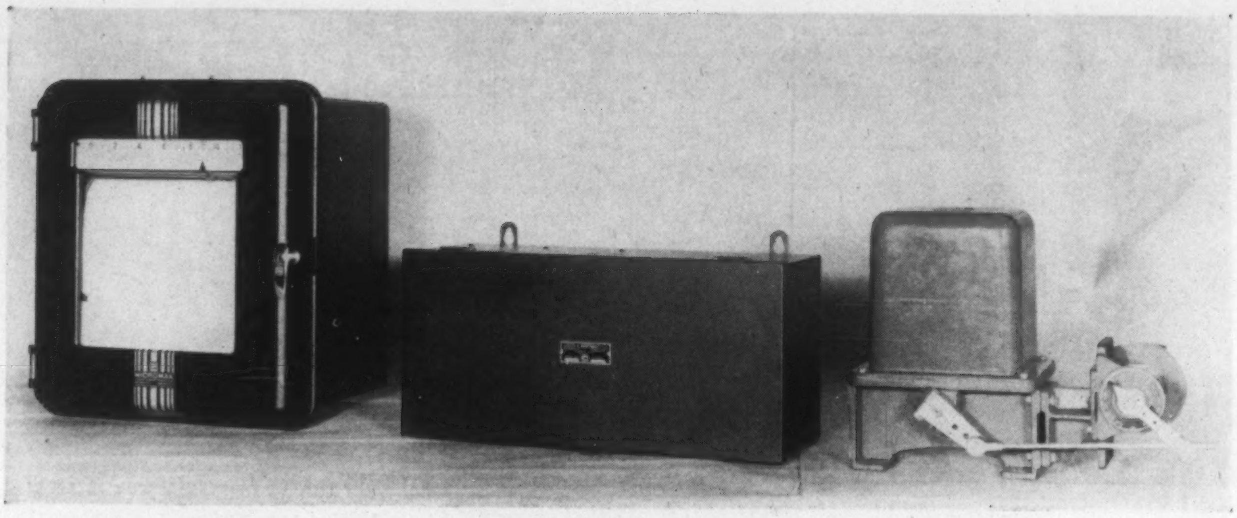


The Spectrum Camera QN 24 Exhibited for the First Time by Carl Zeiss, Inc., New York.

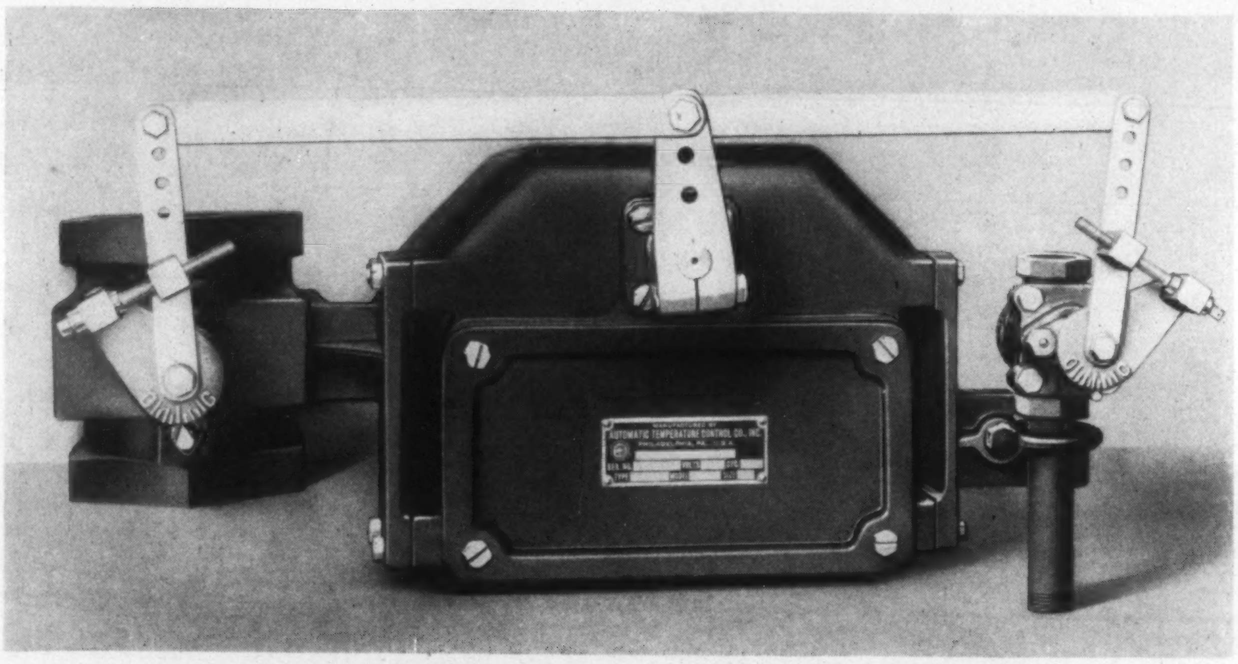


Special Radiant Tube Exhibit of the Surface Combustion Corp., Toledo, Ohio. It is Believed this is the First Time a Radiant Tube in Operation has been Displayed.

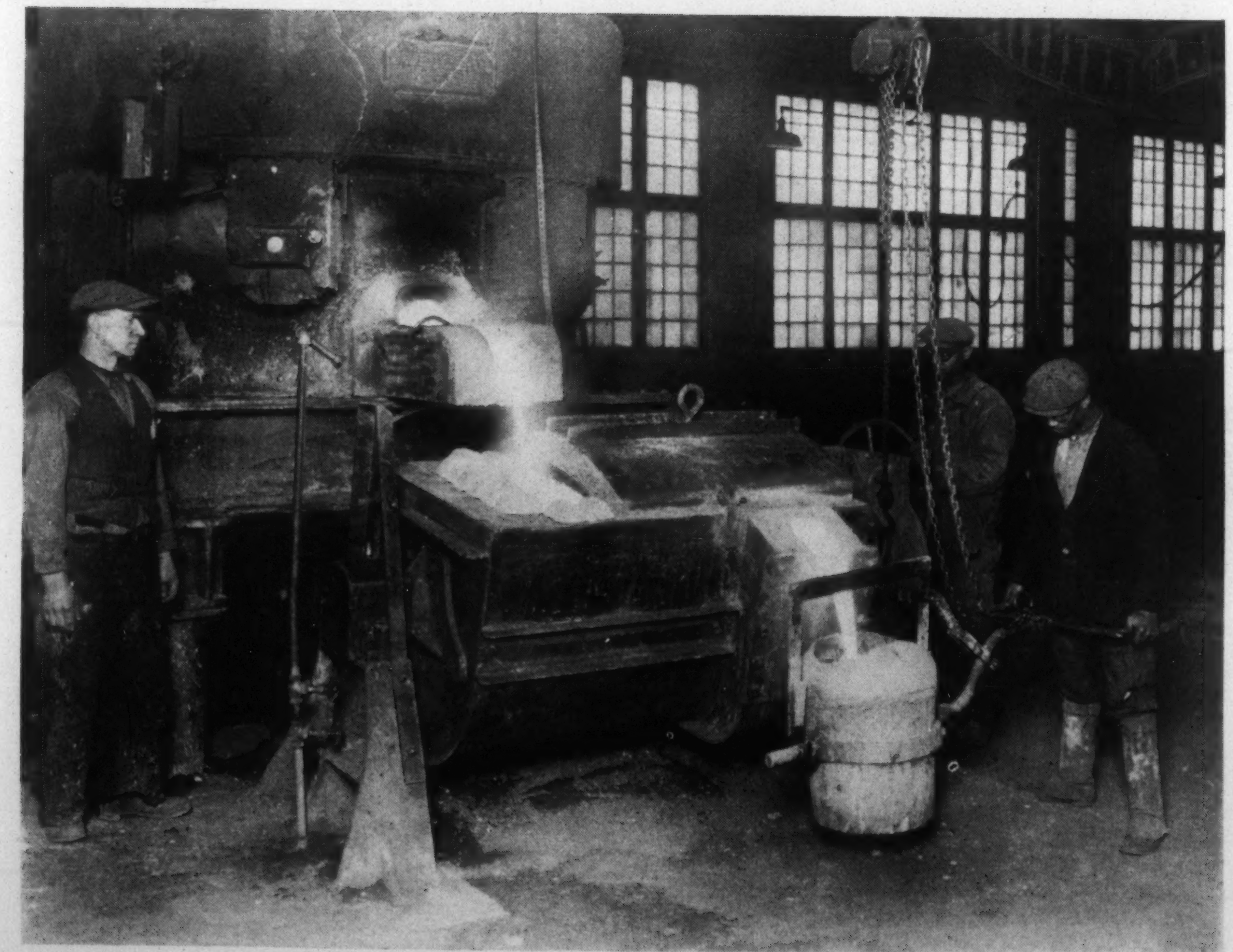




The Micromax Electric Control of the Leeds & Northrup Co., Philadelphia.

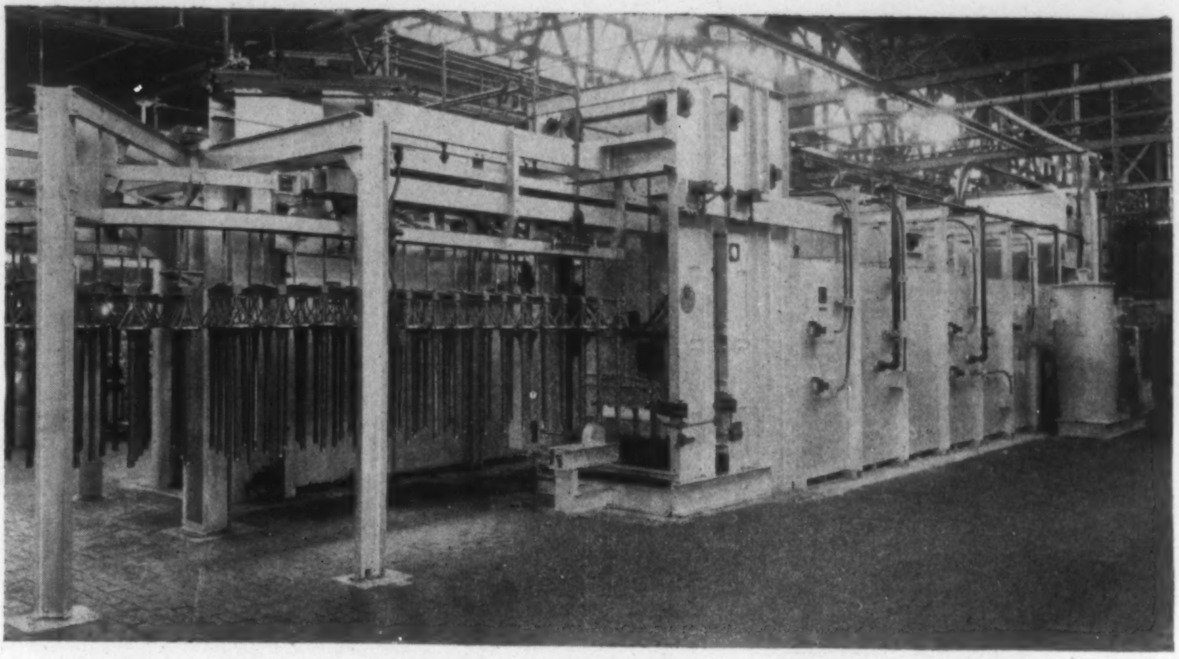


The Relatrol Controller of the Automatic Temperature Control Co., Inc., Philadelphia, Mounted with Oil and Air Valves Giving Constant Ratio of Fuel to Air at any Per Cent of Opening.



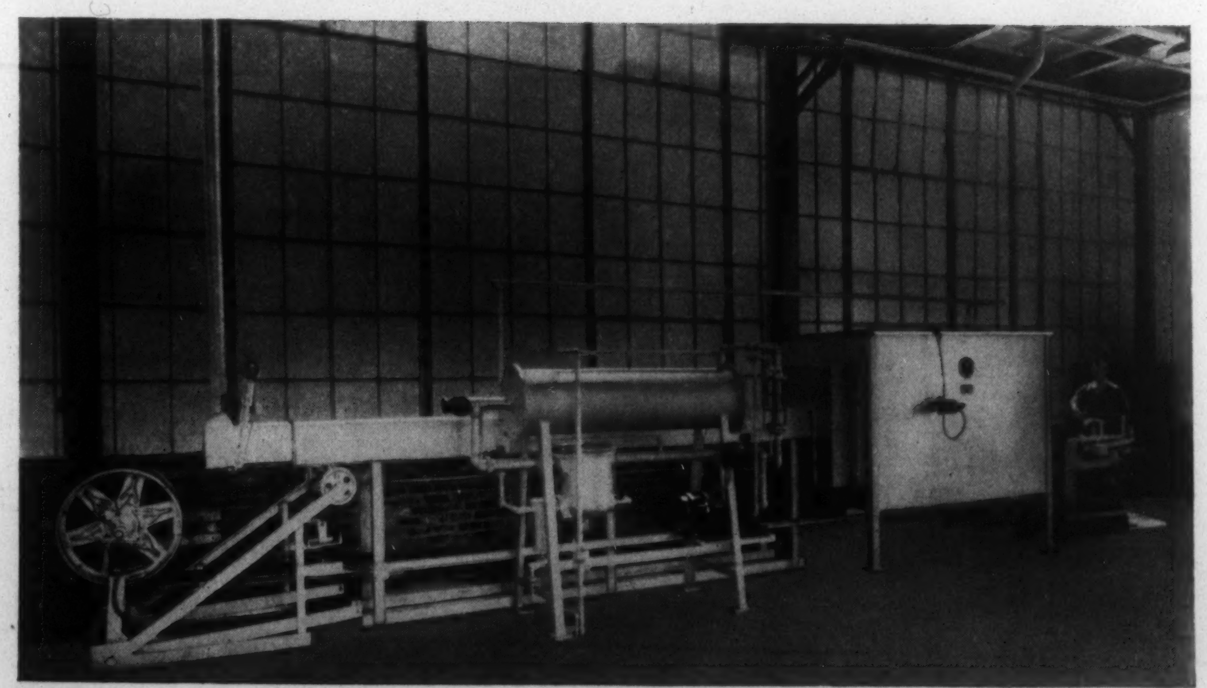
One of the New Elongated Mixer Ladles of the Mathieson Alkali Works, New York. It is used in connection with refining iron with "Purite."

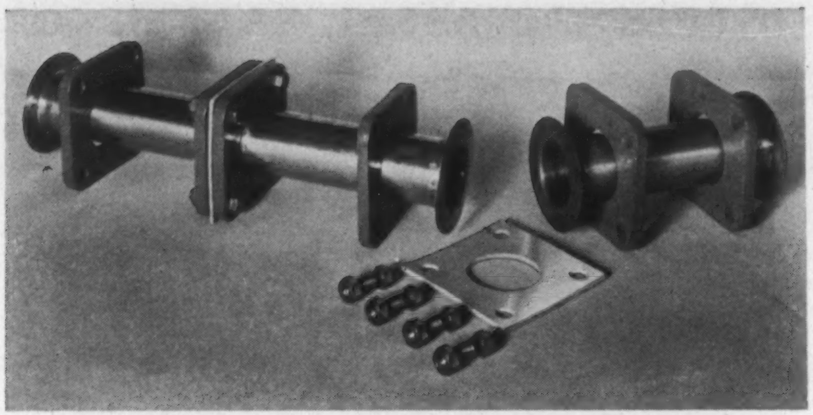
New, Completely Automatic Special Atmosphere Furnace and Equipment for Scale-Free Heat Treating Axles Continuously, Recently Installed by the Electric Furnace Co., Salem, Ohio. It is Believed to be the First of its Kind.



New Research Model Metallographic Equipment of the Bausch & Lomb Optical Co., Rochester, N. Y.

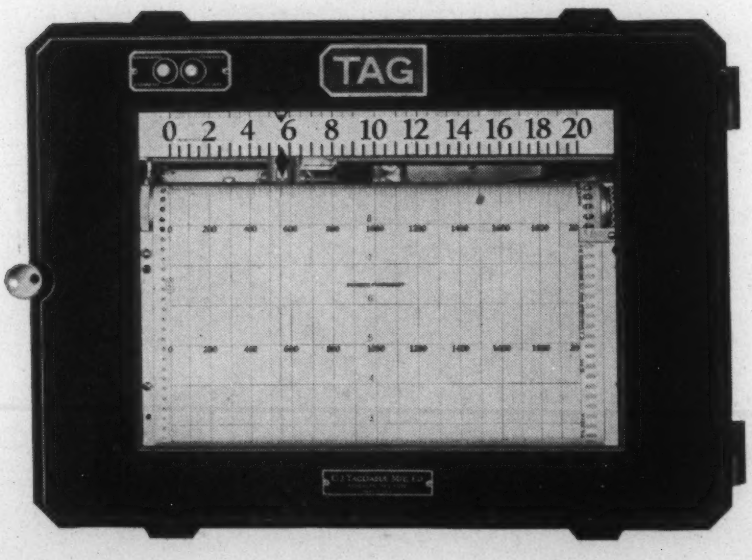
A Controlled Atmosphere Mesh Belt Brazing Furnace of the General Electric Co., Schenectady, N. Y., Exhibited in Operation.





Thin Wall Tubing for Pipe Lines Exhibited by the International Nickel Co., New York.

A New Light Weight Torch, the "Rego SX Torch," Exhibited by the Bastian-Blessing Co., Chicago.

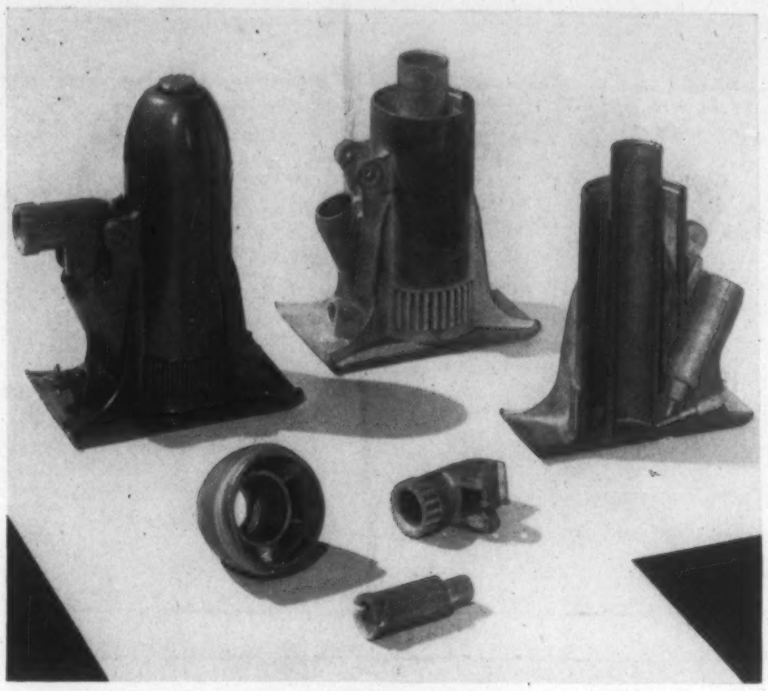

TAG
0 2 4 6 8 10 12 14 16 18 20

The Recently Developed "Tag 2-and 3"—Position Recording Controlling Pyrometer of the C. J. Tagliabue Mfg. Co., Brooklyn.

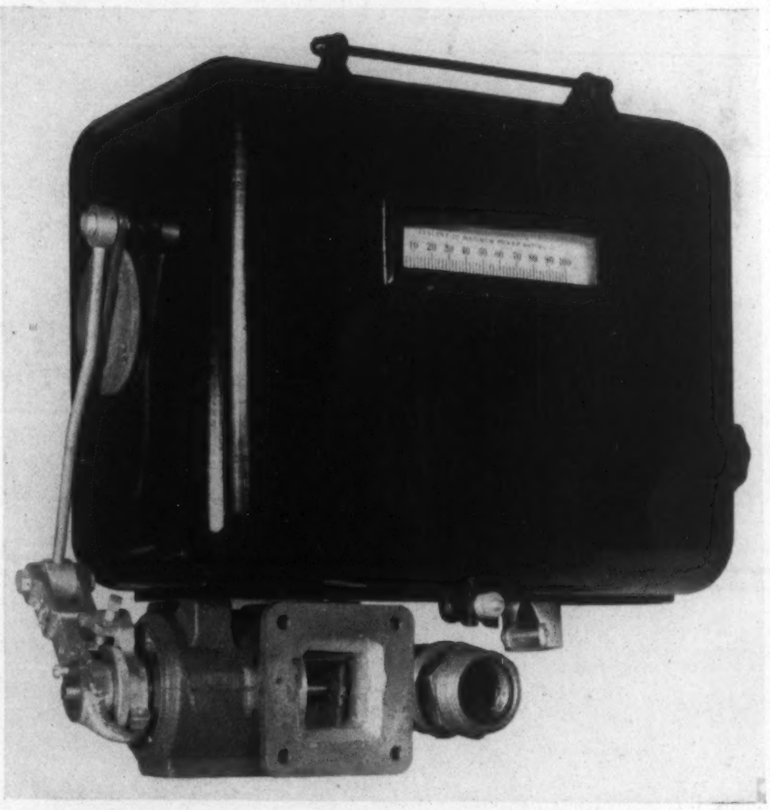
STOPPER
NOZZLE
NOZZLE
SLEEVE
STOPPER
SLEEVE
STOPPER

Some of the Latest Developments in Stoppers, Nozzles and Sleeves Produced by the Joseph Dixon Crucible Co., Jersey City, N. J.

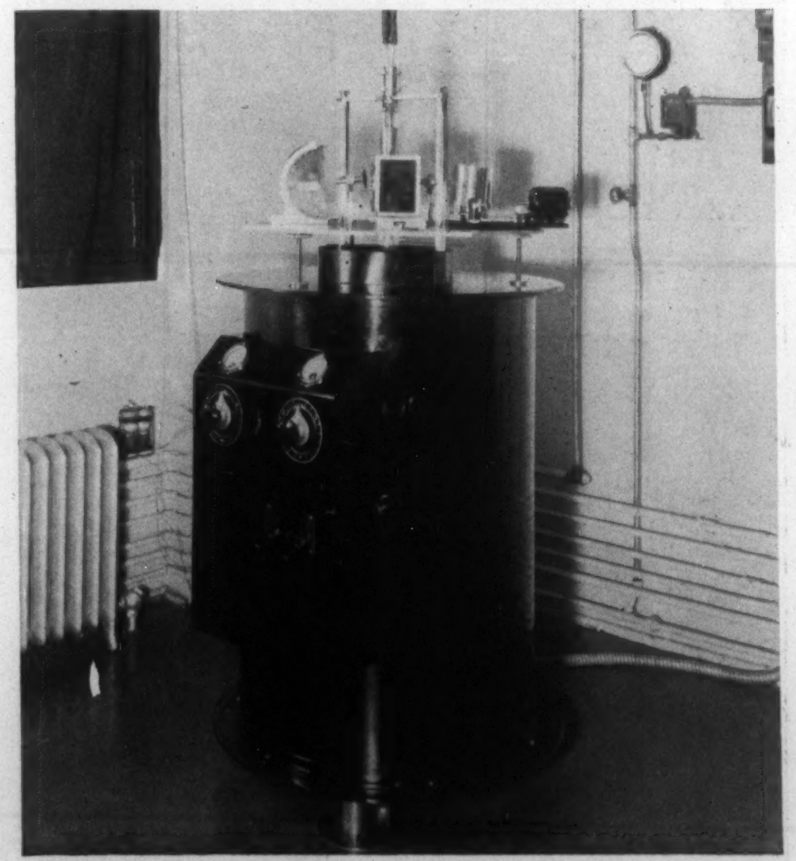
Among a Large Assortment of Die Castings Exhibited by the New Jersey Zinc Co., New York, is the Hydraulic Jack and its Various Zinc Alloy Die-Cast Parts.

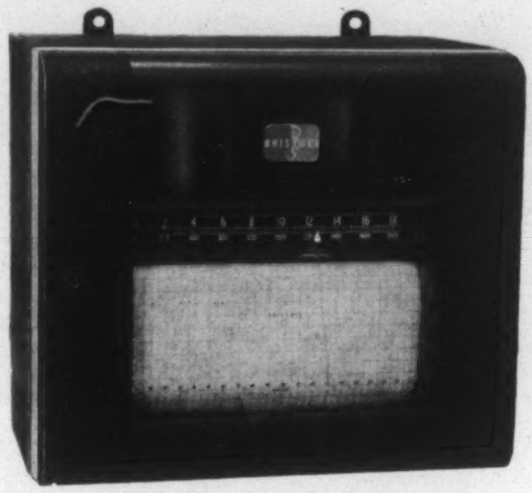


The Lindberg Throttling Control, a New Type of Temperature Control Unit, Produced by the Lindberg Engineering Co., Chicago.

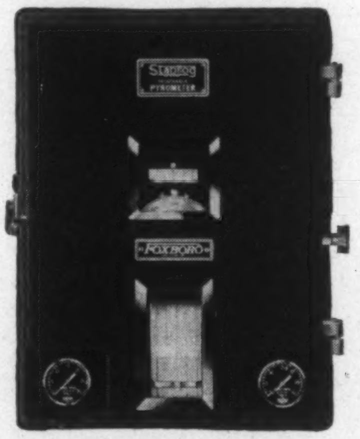


The GE-Hayes Spectrograph Exhibited by the General Electric X-Ray Corp., Chicago.

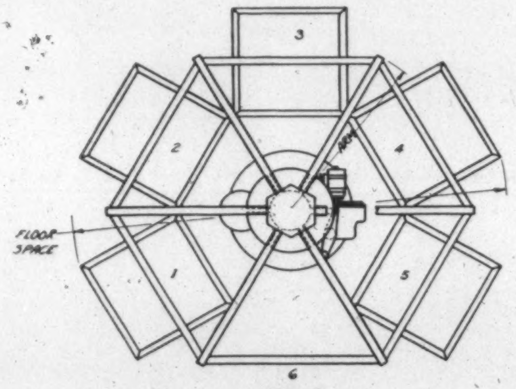




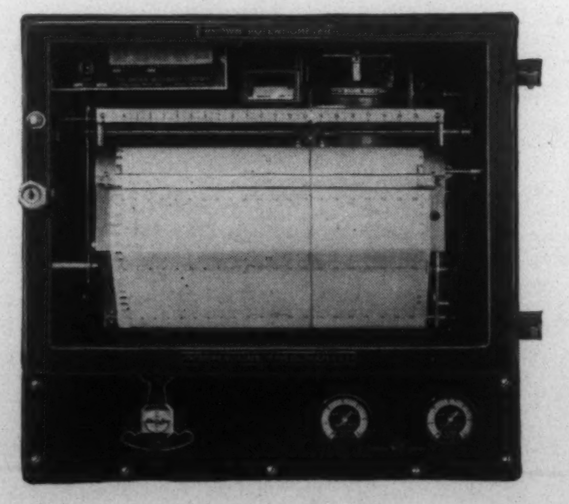
Wide-Strip Potentiometer-Type Pyrometer Exhibited by the Bristol Co., Waterbury, Conn.



The Stabilog Potentiometer Controller with Deviation Record Exhibited by the Foxboro Co., Foxboro, Mass.



General Plan of the Bullard-Dunn Process for Descaling Metals Exhibited by the Bullard Co., Bridgeport, Conn.



Air-o-Line Potentiometer Controller Exhibited by the Brown Instrument Co., Philadelphia.

ARSENICAL and ARGENTIFEROUS COPPER

by J. L. Gregg
Metallurgist, Battelle Memorial Institute

A. C. S. Monograph No. 67

IN its preparation it has not been regarded as sufficient merely to point out the special properties of the argentiferous and arsenical coppers, but as a background for an understanding of these there has been compiled a general account of copper itself in all its phases. The monograph constitutes one of the most authentic and complete, as it is certainly the most up-to-date, of compendiums on the properties and uses of the metals. Nowhere else will such modern knowledge of this ancient metal be found in so few pages.

CHAPTERS

Historical and General
Copper and Its Alloys in Ancient Times—The History and Development of Copper Mining—The Development of Copper Refining—Classification of Copper by Origin and Uses.

Properties and Uses of Copper
Physical Properties—Electrical Conductivity—Chemical Properties—Uses of Copper.

Arsenical and Argentiferous Copper
Geology of Lake Copper—Concentration—Smelting and Refining—Casting—Mechanical Working.

Constitution of Arsenical and Argentiferous Copper
The Copper-oxygen System—The Copper-arsenic System—The Copper-silver System—Complex Alloys

Electrical and Thermal Properties of Arsenical and Argentiferous Copper
The Effect of Oxygen on Electrical Conductivity—The Effect of Arsenic on Electrical Conductivity—Electrical Conductivity of Argentiferous Copper—Influence of Magnetic Field on Electrical Conductivity—Thermal Electromotive Force—Thermal Conductivity—Thermal Expansion.

Mechanical Properties of Arsenical and Argentiferous Copper and Copper Alloys
Effect of Arsenic on Tough-pitch Copper—Deoxidized Arsenical Copper—Effect of Silver on Mechanical Properties of Copper—Effect of Arsenic and Silver on the High-temperature properties of Copper—Effect of Arsenic and Silver on the Annealing Temperature of Copper—Effect of Arsenic on the Mechanical Properties of Copper-base Alloys.

Corrosion of Arsenical Copper and Brass
Principles of Corrosion-chemical—Electrochemical Principles—Season Cracking—Atmosphere Corrosion—Fresh-water Corrosion—Sea-water Corrosion—Gaseous Corrosion at Elevated Temperatures.

Uses of Arsenical and Argentiferous Copper

Appendix—Bibliography

192 Pages Illustrated $4.00

Reinhold Publishing Corporation
330 West 42nd Street New York, U. S. A.

A. S. M. Program

(Continued from page P7)

AFTERNOON

Symposium on "Plastic Working of Metals" (concluded).

Simultaneous Session

"Investigation of Fatigue Strength of Axles, Press Fits, Surface Rolling and Effect of Size," by T. V. Buckwalter and O. J. Horger, Timken Steel & Tube Co., Canton, O.

"Endurance of Gear Steels at 250 Degrees Fahr.," by A. L. Boegehold, General Motors Corp., Detroit.

"Recovery of Cold-Worked Nickel at Elevated Temperatures," by Erich Fetz, Wilbur B. Driver Co., Newark, N. J.

Educational Course: "Physical Testing of Metals," lecture No. 5, by H. D. Churchill.

Papers Scheduled for Symposium on "Plastic Working of Metals"

"Laws and Fundamentals of Plastic Deformation," by A. V. deForest, Massachusetts Institute of Technology, Cambridge, Mass.

"Metallic Single Crystals and Plastic Deformation," by S. L. Hoyt, A. O. Smith Corp., Milwaukee.

"Creep Characteristics of Metals at Elevated Temperatures," by C. L. Clark and A. E. White, University of Michigan, Ann Arbor, Mich.

"Interpretation and Use of Creep Results," by J. J. Kanter, Crane Co., Chicago.

"Elastic Properties and Their Relationship to Strain Hardening," by M. F. Sayre, Union College, Schenectady, N. Y.

"Effect of Shape of Test Piece upon the Energy Needed to Deform Materials in the Single-Blow Drop Test," by O. W. Ellis, Ontario Research Foundation, Toronto, Ont.

"Hot Working, Cold Working and Recrystallization Structure of Metals," by N. P. Goss, Cold Metal Process Co., Youngstown, O.

"Factors Relating to the Production of Drop and Hammer Forgings," by Adam Steever, Columbia Tool Steel Co., Chicago Heights, Ill.

"Hot Press and Upset Forging," by J. H. Friedman, National Machinery Co., Tiffin, O.

"Extrusion of Metals," by D. K. Crampton, Chase Brass & Copper Co., Waterbury, Conn.

"Cold Heading—Bolts, Rivets and Nails," by R. H. Smith, Lamson & Sessions Co., Kent. O.

"Ductility of Steel in Wire Drawing," by H. B. Pulsifer, American Steel & Wire Co., Cleveland.

"Cold Forming Processes—Drawing Rods and Bars," by J. E. Beck, Jones & Laughlin Steel Corp., Pittsburgh.

"Cold Drawing Processes: Making of Tubing," by Horace Knerr, Metallurgical Laboratories, Inc., Philadelphia.

"Cold Rolling of Mild Steel Sheets and Strip," by Anson Hayes and R. S. Burns, American Rolling Mill Co., Middletown, O.

"Some Factors Affecting the Plastic Deformation of Sheet and Strip Steel and Their Relation to the Deep Drawing Properties," by Joseph Winlock and R. W. E. Leiter, Edward G. Budd Mfg. Co., Philadelphia.

"Cold Working of Hollow Cylinders by Auto-Frettage," by N. E. Woldman, Eclipse Aviation Corp., East Orange, N. J.

"Damping Characteristics of Metals," by G. R. Brophy, General Electric Co., Schenectady, N. Y.

TYPICAL AMSCO A

THE group of AMSCO Alloy castings illustrated are typi
AMSCO Alloy is successfully employed to withstand e
gases, and corrosive liquids.

(1) Lead Stirring Blades of AMSCO Alloy F-10. Weight 94 pounds each.
(2) Marine Boiler Hangers of AMSCO Alloy F-10. Weight 1½ pounds each.
(3) Hearth Plates of AMSCO Alloy F-10; right, left and center pieces. Weights 180 to 187 pounds.
(4) AMSCO Alloy F-10 Combustion Nozzles. Weight 45 pounds.
(5) An Ore Roasting Furnace Rabble Blade of AMSCO Alloy F-3.
(6) In and Out Rabble Blades of AMSCO Alloy F-3 for an ore roasting furnace.
(7) Two Burner Nozzles of AMSCO Alloy F-10. Weight 72 pounds each.
(8) 16" U-type Furnace Discs of AMSCO Alloy F-10. Weight 33 pounds each.
(9) Lead Hardening Pots of AMSCO Alloy F-10. Weight 25 pounds each.
(10) A Lead Pan of AMSCO Alloy F-10. Weight 144 pounds.
(11) A Coal Burner Nozzle of AMSCO Alloy F-10. Weight 62 pounds.

No matter what your needs may be—if the part must be he
Longtime, satisfactory service is thus assured!

AMERICAN MANGANES

Division of American Brake S

384 EAST 14th STREET, CHIC

Foundries at: Chicago Heights, Ill.; Newcastle, Del.;
OFFICES IN PRIN

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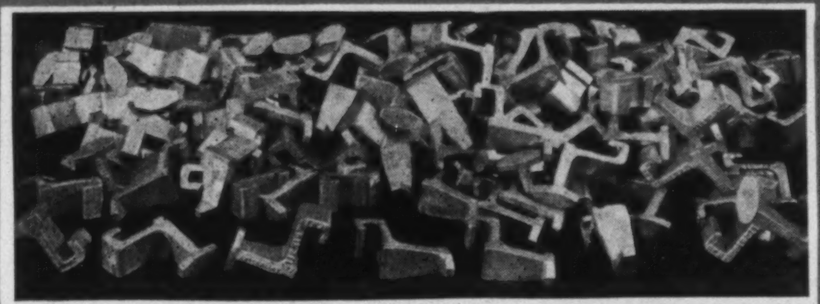
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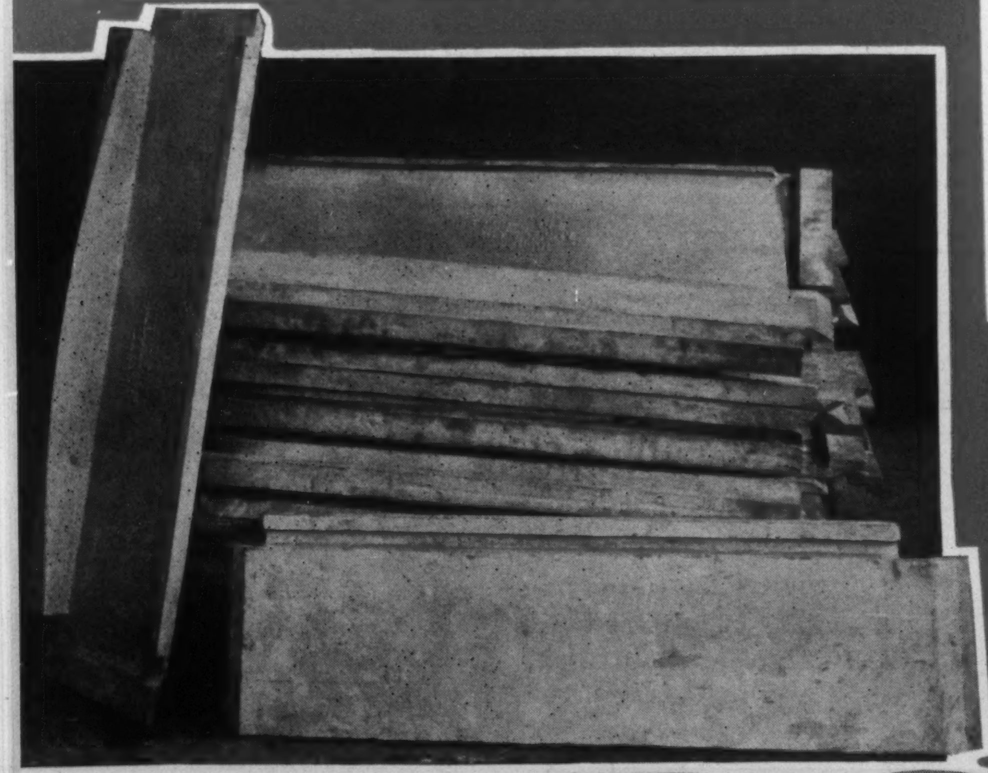
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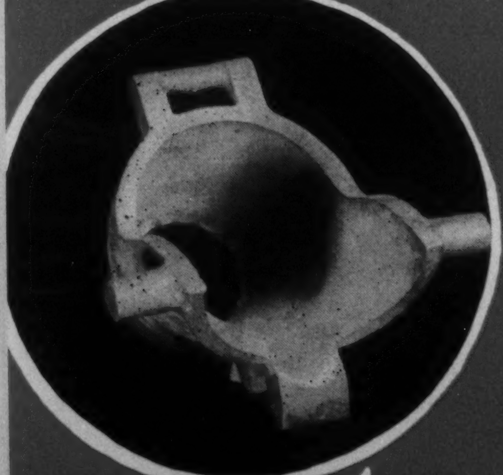
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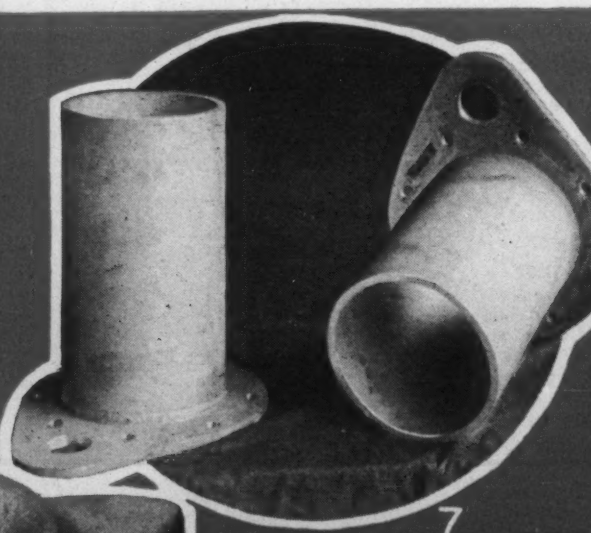
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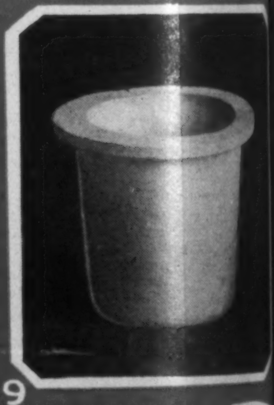
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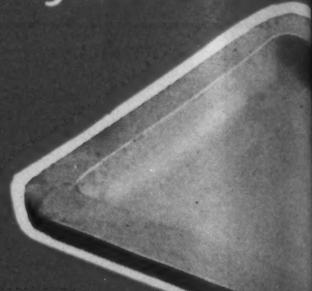

AMSCO

DUAL *Continuous* CONTROL

and the New

"SHIELD-ARC S. A. E." *Welder*

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MANUFACTURERS' LITERATURE

Industrial Products

The 1936 edition of this catalog contains information and recommendations on high and low temperature insulations for every industrial need, specifications on J-M bonded asbestos built-up roofs, and J-M insulated roofs, detailed information on J-M corrugated Transite for roofings and sidings; on industrial friction materials, etc. Illustrated. Johns-Manville, New York, N. Y. (996)

Gas Carburizing

Leaflet SC-77 discusses the Eutectrol process of continuous gas carburizing and claims the following among its advantages: accurate control of depth, increased rate of penetration, savings of from 35 to 60 per cent; labor costs are cut to a minimum. Illustrated. Surface Combustion Corp., Toledo, O. (997)

Extensometer

The Kenyon-Burns-Young extensometer is described and illustrated in Bulletin 128. It is claimed that this equipment determines the deep drawing qualities of sheet metal accurately. Illustrated. Baldwin-Southwark Corp., Philadelphia, Pa. (998)

Nickel Alloy Steels

The properties and applications of heat treated wrought nickel alloy steels, in sections up to about 6 inches in diameter or thickness, are discussed in Bulletin P-1. The International Nickel Co., Inc., New York, N. Y. (999)

Mo-Max

This high-speed molybdenum-tungsten steel for cutting tools is the subject of a leaflet of The Cleveland Twist Drill Co., Cleveland, O. (1000)

Cupola Blowing

Motorblowers avoid the loss of air and coke by accurately controlling the weight of air supplied to the cupola. The principles of operation of this automatic air-weight control are described and illustrated in a bulletin issued by Ingersoll-Rand, New York, N. Y. (1001)

Alloy Castings

Bulletin 1513 contains illustrations of various oxidation, corrosion and abrasion-resisting castings manufactured by the National Alloy Steel Co., Blawnox, Pa. (1002)

Tool Steel

A colorful leaflet devoted to Saratoga oil-hardening, non-shrinking tool steel contains data on analysis, applications and heat treatment. Ludlum Steel Co., Watervliet, N. Y. (1003)

3300 Deg. Super Refractory

An illustrated catalog devoted to "Shamva" Mullite contains information regarding its background, characteristics and uses. Mullite Refractories Co., Shelton, Conn. (1004)

Stainless and Heat Resisting Steels

The application of stainless steels in the process industries is the subject of an attractive, illustrated, brochure. Physical and mechanical properties of the various grades of the corporation's stainless are included. United States Steel Corp. Subsidiaries, Pittsburgh, Pa. (1005)

Controlled Grain Anodes

Seymour Nickel Anodes are homogeneous in grain structure, according to this bulletin. The various available shapes are illustrated and some useful data are given. The Seymour Manufacturing Co., Seymour, Conn. (1006)

Stainless and Heat Resisting Electrodes

A colorful price list and data book containing complete descriptions of the company's products and also analyses of stainless and heat resisting alloys manufactured by other companies has been issued by Maurath, Inc., Cleveland, O. (1007)

Manganese Steel

The story of manganese steel is told in an attractively illustrated leaflet. Data on chemical content and physical properties are given. American Manganese Steel Co., Chicago Heights, Ill. (1008)

Yoloy

A colorful bulletin summarizes the properties of the above alloy steel and lists the physical properties of two typical steels in the Yoloy series. It is claimed to be corrosion resistant and to have high tensile strength and high ductility. Youngstown Sheet and Tube Co., Youngstown, O. (1009)

Gas Fired Furnace

The manufacturer of the gas fired Lindberg Cyclone furnace for heating at temperatures from 250 deg. F. to 1400 deg. F. claims that the heating rate is remarkably fast, and either open or extremely dense charges are handled with equal facility. The principle of the furnace is described in Bulletin 51. Illustrations. Lindberg Engineering Co., Chicago, Ill. (1010)

Salt Bath Furnace

Although the advantages of molten salt baths have been recognized, they have not attained widespread use because of the shortcomings of furnace designs. The Ajax-Hultgren electrically heated salt bath was designed to meet the metallurgical requirements of liquid heat treating operations. Bulletin 103 lists some of the advantages of the furnace. Illustrated. Ajax Electric Co., Inc., Philadelphia, Pa. (1011)

Micromax Thermocouple Pyrometers

A new catalog, N-33A, explains the potentiometer method of measurement, the operation of the mechanisms through which this balance method is made available to industry. The complete line of instruments is set forth. Leeds & Northrup Co., Philadelphia, Pa. (1012)

Inhibitor

Grasselli 3 inhibitor for efficient, economical pickling is the subject of a booklet of The Grasselli Chemical Co., Inc., Cleveland, O. (1013)

What Scientists Say of Leitz Ultropak

Bulletin No. 17 describes the personal experiences and applications to which Ultropak has been placed by scientific workers in various fields. E. Leitz, Inc., New York, N. Y. (1014)

The Jetal Process

Simple immersion in an aqueous bath for about 5 minutes colors all grades of common iron or steel a brilliant and uniform jet black. It is claimed it does not alter dimensions of articles and cannot chip, scale, peel or discolor. Alrose Chemical Co., Providence, R. I. (1015)

Ferrocarbo

This material containing both silicon and carbon combined in the form of silicon carbide acts as a graphitizer or softener when added to cast iron. The manufacturer claims that when Ferrocarbo is used with a properly adjusted charge, the fine graphite structure and high strength characteristic of a hard charge are combined with a high degree of machinability. Carborundum Co., Niagara Falls, N. Y. (1016)

Stainless Steel Castings

An attractive booklet contains useful information on the subject. Typical analyses, characteristics and suggested uses are listed. Joseph T. Ryerson & Son, Inc., Chicago, Ill. (1017)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (1018)

Alloy Castings

Corrosion resistant and stainless steel castings are the subject of a new booklet. Chemical and metallurgical properties of these castings are included. Illustrated. Michiana Products Corp., Michigan City, Ind. (1019)

Free Cutting Steel

An attractive booklet records fifteen years spent by the company's metallurgical department in research on the machinability of free cutting steels. Jones & Laughlin Steel Corp., Pittsburgh, Pa. (1020)

Dolomite Refractories

This interesting pamphlet presents the case of Clinkered vs. Calcined Dolomite in the basic open-hearth steel furnace. Basic-Dolomite, Inc., Cleveland, O. (1021)

Cor-Ten and Man-Ten

Pamphlet describing high-tensile steels developed to meet the needs of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (1022)

Application of Heat to Core Baking

A profusely illustrated booklet containing information resulting from research on the subject has been published by the American Gas Association, New York, N. Y. (1023)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (1024)

Brazing Alloys

The results of both laboratory and actual production data are contained in Bulletin No. 1 entitled "How to Use 'Handy' Silver Solders, Sil-Fos and Easy-Flo Brazing Alloys," as well as detailed instructions and helpful hints about soldering and brazing with silver alloys. Handy & Harman, New York, N. Y. (1025)

Special Atmospheres in the Heat Treatment and Brazing of Metals

A reprint of the above article by C. L. West, Research Engineer, is offered by The Electric Furnace Co., Salem, O. (1026)

MANUFACTURERS' LITERATURE

Dipping Baskets

If none of the 14 standard designs meets the customer's approval, this company will manufacture baskets to specifications. As a general guide in selecting the baskets suitable for one's needs, the chemical action on several commonly used metals is given. Illustrated. C. O. Jelliff Mfg. Corp., Southport, Conn. (1027)

Braze-Rite Furnace

This furnace, developed principally for brazing sintered carbide cutting tools, provides for localized heat to be applied only to the portion of the tool to be brazed. Illustrated. Firth-Sterling Steel Co., McKeesport, Pa. (1028)

Electric Arc Welding

The Manual for Training Operators contains very complete information on the subject. General information, theory of arc-welding, complete set of lessons and tests on the fundamentals of the metallic arc-welding process are some of the features. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. (1029)

Everdur

This metal is a high strength, non-magnetic, non-sparking alloy of the solid solution type composed of copper, silicon and other controlled elements, according to this illustrated leaflet. It is stated that this alloy is unusually resistant to corrosive gases and saline fogs and has excellent machining and working characteristics. American Brass Co., Waterbury, Conn. (1030)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections Available Forms and Shop Practice, has been published by The Dow Chemical Co., Midland, Mich. (1031)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (1032)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (1033)

Bolts, Nuts, Screws and Washers

A very complete catalog and price list of the above products is offered by The H. M. Harper Co., Chicago, Ill. (1034)

Car Hearth Furnaces

Bulletin C-736 is devoted to these furnaces which were designed for uniform heating, sturdy construction and fuel economy. They can be built to use fuel oil, city gas, natural gas, butane or propane as fuel. Illustrated. The Philadelphia Drying Machinery Co., Philadelphia, Pa. (1035)

Drop Forging Topics

Interesting articles are included in this illustrated publication of the Drop Forging Association, Cleveland, O. (1036)

Black Metal Paint

A colorful new folder describing the use of Koppax paint on all metal surfaces has been issued. It is claimed to be water, heat and corrosion-resistant. Koppers Products Co., Pittsburgh, Pa. (1037)

Nichrome

Catalog R-36 was designed to cover the properties and characteristics of alloys for electrical, mechanical and chemical purposes. Illustrations and tables. Driver-Harris Company, Harrison, N. J. (1038)

Testing Machines

Catalog 50, Part L, features Olsen Universal testing machines. Complete descriptions and illustrations. Tinius Olsen Testing Machine Co., Philadelphia, Pa. (1039)

Alloy Steels Simplified

A looseleaf booklet has been published in an attempt to simplify the alloy steels as far as possible and still cover the complete requirements of the small buyer. Descriptions and tables of physical properties included. Attractively illustrated. The Carpenter Steel Co., Reading, Pa. (1040)

Limitrol

These instruments which are used in conjunction with or without controllers of any type to protect the furnace and furnace loads from excessive heating due to a weakness in control or a failure in switching apparatus to function are illustrated and described in a folder of the Wheelco Instruments Co., Chicago, Ill. (1041)

Molybdenum

Data concerning the effect of molybdenum on gray iron properties are contained in an illustrated booklet. The procedure in making the tests is outlined and a brief discussion of the results is included. Climax Molybdenum Co., New York, N. Y. (1042)

Alloy Steels

A leaflet contains the claims that among the advantages of this company's processes are: radical reduction of machining costs; accurate size and cross section; bright finish; straightness and correct analyses. Union Drawn Steel Co., Massillon, O. (1043)

Forged Flanges

Bulletin No. 125 contains a list of stock flanges. The list includes dimension, weights and prices on standard flanges in all sizes from ¾ to 24 in., as well as engineering data on standard flange facings, drilling templates, etc. Kropp Forge Co., Chicago, Ill. (1044)

Cycle Controller

The Model 6088V controller, which has adjustable features making it suitable for use where variable speed controllers are required, particularly in the rubber and molded plastic industries, is described in Bulletin No. 447.

Published by the same company: Bulletin No. 457 describes the Pyrotrol which is a safety device for use on gas-fired industrial ovens. The Bristol Co., Waterbury, Conn. (1045)

Fire Clay Products

A folder contains brief descriptions of the Goose Lake products and Therm-O-flake (for high temperature insulation) products. Illinois Clay Products Co., Joliet, Ill. (1046)

High Frequency Electric Power Converters

According to an illustrated pamphlet this company presents to the users of high frequency energy, other than wireless communication, equipment well capable of fulfilling the requirements of overall efficiency, durability, flexibility, ruggedness, etc. Lepel High Frequency Laboratories, Inc., New York, N. Y. (1047)

Metal Cleaning

The Bullard-Dunn process for metal cleaning is discussed in Bulletin BD 27. Bullard Company, Bridgeport, Conn. (1048)

New Method Annealing

Pamphlet containing data on this method. Illustrated. Power curves, comparison of annealing costs, etc. The Bellis Co., Branford, Conn. (1049)

High Temperature Creep Values of Low Priced Alloy Still Tubes

Up-to-date circular which supersedes Circular Letter No. 2A, Nov. 1, 1933, bearing the same title. The Calorizing Co., Pittsburgh, Pa. (1050)

Modern Gathmann Methods

A leaflet illustrates some of these methods and tells why they are vital to makers and users of steel. The Gathmann Engineering Co., Baltimore, Md. (1051)

Nitralloy and Nitricastiron

Leaflet describing three groups of Nitralloy. It also discusses the special alloy steels classified as "Nitrard" and "Nitricastiron," their nitrided cast iron. The Nitralloy Corp., New York, N. Y. (1052)

Hardening Control

Useful information regarding case hardening steel is contained in a booklet of the A. F. Holden Co., New Haven, Conn. (1053)

Better Castings

Interesting information is contained in this publication which is distributed by the Niagara Falls Smelting and Refining Corp., Buffalo, N. Y. (1054)

Aluminum

An attractive booklet "Aluminum in Shopfitting and Display" contains a section devoted to practical points on use and fabrication. Arthur Seligman & Co., Inc., New York, N. Y. (1055)

Nickel-Clad Steel

A new bulletin (T-4) on methods for the fabrication of this company's nickel-clad steel contains data accumulated during the past five years. Illustrated. Lukens Steel Company, Coatesville, Pa. (1056)

Pure Carbide-Free Metals

These metals are described and applications suggested in Pamphlet No. 20. Heating Thermit Cans are also described and illustrated. Metal and Thermit Corp., New York, N. Y. (1057)

MANUFACTURERS' LITERATURE

Rapid Moore Lectromelt Furnaces

Bulletin No. TC illustrates and describes patented lift and swing-aside-roof type quick top-charge electric melting and refining furnaces. Pittsburgh Lectromelt Furnace Corp., Pittsburgh, Pa. (1058)

Ampco Metal

Engineering data of a general nature is offered in Catalog No. 21. Technical explanations have been written so that the layman may understand them. It is claimed that this metal is a "process metal" and not just "another special bronze." Illustrations. Ampco Metal, Inc., Milwaukee, Wis. (1059)

Metal Powders

An attractive leaflet contains a list of metal powders with percentages of metals and mesh in which they are obtainable. Charles Hardy, Inc., New York, N. Y. (1060)

Heat and Acid Resisting Castings

Bulletin No. 21 lists the most popular analyses of Standard-Alloy together with safe workable loads at different temperatures. The Standard Alloy Company, Cleveland, O. (1061)

High Temperature Fans

Hi-Temp fans suitable for temperatures up to 1400 deg. F., for heat interchangers, furnace heat recirculation, etc., are discussed in a leaflet which contains a table showing size of fan for different conditions. Illustrated. General Combustion Corp., Chicago, Ill. (1062)

Aluminum Flux

A pamphlet entitled "Look into the Ladle" describes how this flux supplies the chemical and metallurgical needs in the melting of aluminum. The Maluminum Co., Indianapolis, Ind. (1063)

Rolling Mill Bearing Problems

A book entitled "The Answer to Rolling Mill Bearing Problems" contains the statement that there is a Timken bearing for every rolling mill requirement. A list of Timken installations is included. The Timken Roller Bearing Co., Canton, O. (1064)

Laboratory Supports and Supplies

Stability, accuracy, durability, variety and convenience and economy are claimed as advantages of the use of Universal supports listed in Catalog S-2. Illustrations and index are included. The Gaertner Scientific Corp., Chicago, Ill. (1065)

Multi-Rotary Table

The Wheelabrator multi-rotary table —the airless abrasive method of cleaning fragile or intricate metal parts— is described in Folder No. 33. Illustrated. The American Foundry Equipment Co., Mishawaka, Ind. (1066)

Surface Hardening by Induction

The TOCCO Process which, it is claimed, reduces hours of surface-hardening time to seconds and produces a scientifically regulated, exact result, is discussed in an attractive illustrated leaflet of The Ohio Crankshaft Co., Cleveland, O. (1067)

Duraloy

Chrome-nickel and chrome-iron alloy groups with recommended applications are listed in a new pamphlet from this company. Centrifugal castings and recuperators are discussed and a table of the characteristics of various Duraloys is included. Illustrated. Duraloy Company, Pittsburgh, Pa. (1068)

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (1069)

Air Conditioning Lectrodryer

This equipment is designed for dehumidification and not for temperature control. If additional cooling is desired, auxiliary equipment can be used. Pittsburgh Lectrodryer Corp., Pittsburgh, Pa. (1070)

Heat and Corrosion Resistant Alloys Heated By Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (1071)

Electric Welding Products

Catalog No. 101 contains information on welding rods (recommended uses for the different types, physical properties, welding procedure, etc.); miscellaneous apparatus, and Wilson arc welding machines. Air Reduction Sales Co., New York, N. Y. (1072)

Furnace Element Construction

Bulletin HD-636 describes the development of the Hevi Duty element construction in furnaces. Some of the features of these elements are: freely radiated heat from the heating coils; coils are free to expand and contract; and tolerances are allowed for the free expansion of the radiant plates and tee supports and for normal growth of the coils. Hevi Duty Electric Co., Milwaukee, Wis. (1073)

Heavy Duty Refractories

This handbook contains complete descriptions, applications, tables and illustrations of standard shapes. Many useful engineering data are included. Norton Company, Worcester, Mass. (1074)

Rocking Furnace

Type G-M is a small-scale indirect arc electric furnace designed for iron, steel, brass, copper and nickel alloy. The furnace is illustrated and specifications are included in a leaflet which has been prepared by the Detroit Electric Furnace Co., Detroit, Mich. (1075)

Truck Body Construction

Through the use of the light, strong alloys of Alcoa Aluminum, bodies have been built which weigh only 35 to 60 per cent as much as they would have if built of heavier structural materials, according to this catalog. Aluminum Co. of America, Pittsburgh, Pa. (1076)

Furnaces

Information concerning Hausfeld modern melting equipment for die casting is featured in an illustrated leaflet. These furnaces are made interchangeable for oil or gas fuel. Campbell-Hausfeld Co., Harrison, O. (1077)

Castings

Beryllium copper heat treated castings, either finished or unfinished, because of the fatigue, corrosion-resisting, high strength and unusually stable properties of this alloy, are offered to industry to fill the demand for better properties in cast parts, according to The Beryllium Corp. of Pa., Reading, Pa. (1078)

Armco H.T.-50

An illustrated folder devoted to the above alloy steel contains data on the average physical properties, corrosion resistance and forming and welding qualities. American Rolling Mill Co., Middletown, O. (1079)

Firit

This protective coating for heat resisting parts used in foundries, steel and malleable plants, coke ovens, glass and ceramic plants, etc., is the subject of a leaflet which includes information on: what it does, how it is used; economies gained and directions for its use. Foundry Services, Inc., New York, N. Y. (1080)

Alloy Steels

A colorful folder devoted to these steels lists some of the advantages to be obtained by their use. Bliss & Laughlin, Inc., Harvey, Ill. (1081)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. It is claimed that this series represents the best straight cutting oils obtainable, at a price which meets and beats competition. E. F. Houghton & Co., Philadelphia, Pa.. (1082)

Bimetal

A simplified version of its manufacture and the way it works is contained in this pamphlet. W. M. Chace Co., Detroit, Mich. (1083)

Centrifugal Castings

Bulletin C-2 is devoted to these castings which are available in the same analyses as the stationary-cast range of heat and corrosion resistant alloys which they supplement. Michigan Steel Casting Co., Detroit, Mich. (1084)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (1085)

Hi-Steel

Information concerning chemical composition, physical properties and corrosion resistance of this steel is offered by the Inland Steel Company, Chicago, Ill. (1086)

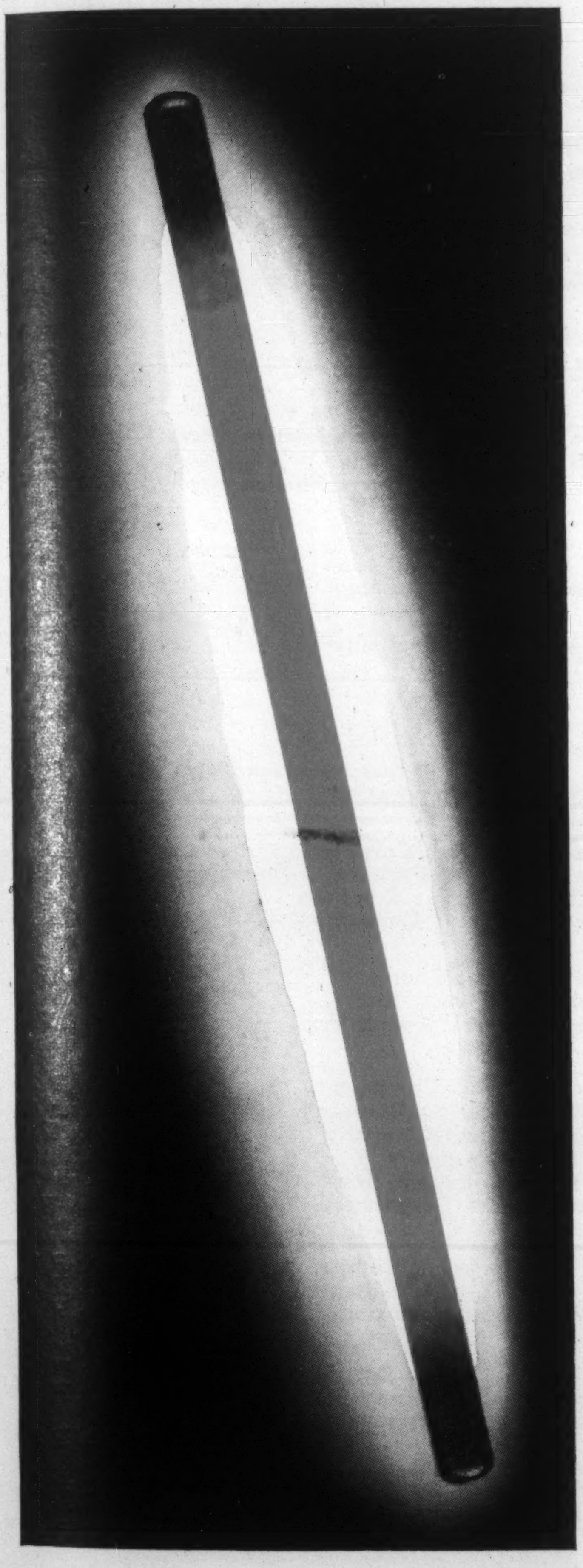
Pot Hardening Furnaces

A looseleaf page has been issued on the improved furnaces of this company. The new features include insulating refractory lining backed by block insulation, heat-resisting alloy burners, single valve control, and numerous small burners with their attendant advantages. Illustrated. American Gas Furnace Co., Elizabeth, N. J. (1087)

Electric Furnaces

A pamphlet describes the "Certain Curtain" furnace which was developed for heat treating at temperatures between 1850 and 2500 deg. F. C. I. Hayes, Inc., Providence, R. I. (1088)

Continuity



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IF continuity of furnace operation is a controlling factor in your production schedule, you owe it to yourself to investigate the possibilities inherent in Globar Brand non-metallic electric heating elements to strengthen your position in this respect. The loss of a single day's production can easily prove disastrous. Breakdowns and subsequent shutdowns are costly; make no mistake about that.

Any high temperature electric furnace that requires prolonged periods for element replacement constitutes a major production hazard. Replacement of elements should be a simple and inexpensive process and, above all, rapid.

In considering any proposal for a high temperature electric furnace, therefore, make certain that the specifications call for elements that can be quickly and easily replaced—in a few moments time—with the furnace continuing in operation.

Globar Brand non-metallic heating elements are inherently long-lived but when they do need replacement, the job can be done in a few minutes by backing off one nut on the spring terminal assembly, and simply inserting a new element, pushing out the old with the same movement. There is no interruption of the process whatsoever.

Consult our engineers when you are figuring on a new furnace installation. You can draw on their wide experience with profit to yourself—and entirely without obligation on your part.

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A Digest of the Important Metallurgical Developments of the World

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Crushing, Grinding & Plant Handling (1a)
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Flotation (1c)
Magnetic Separation (1d)
Amalgamation, Cyanidation & Leaching (1e)

ORE REDUCTION (2)

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Ferrous (2b)

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Cold Working, including Shearing, Punching, Drawing & Stamping (4c)
Machining (4d)

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APPLICATION OF METALS AND ALLOYS (14)

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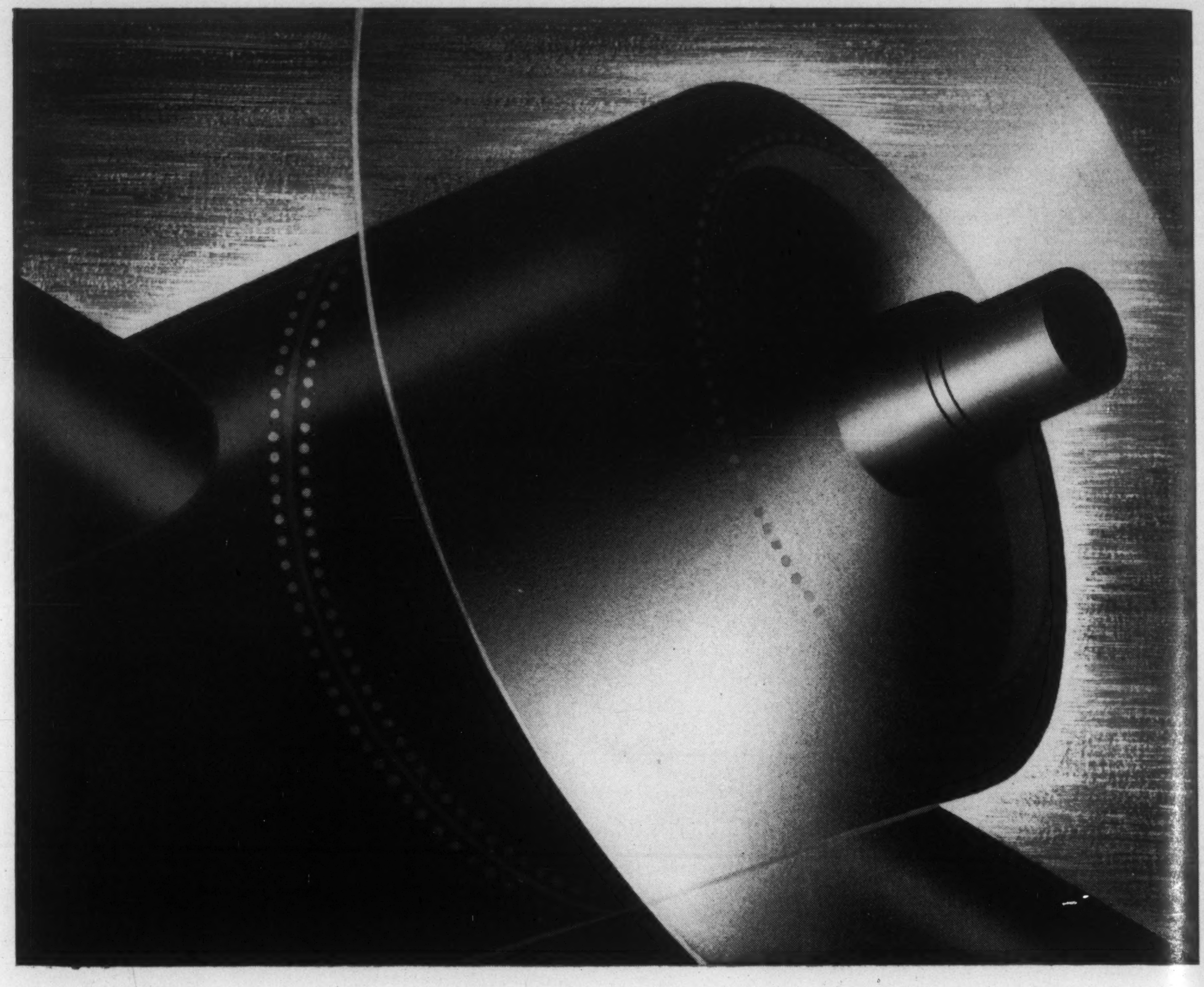
Historical (15b)



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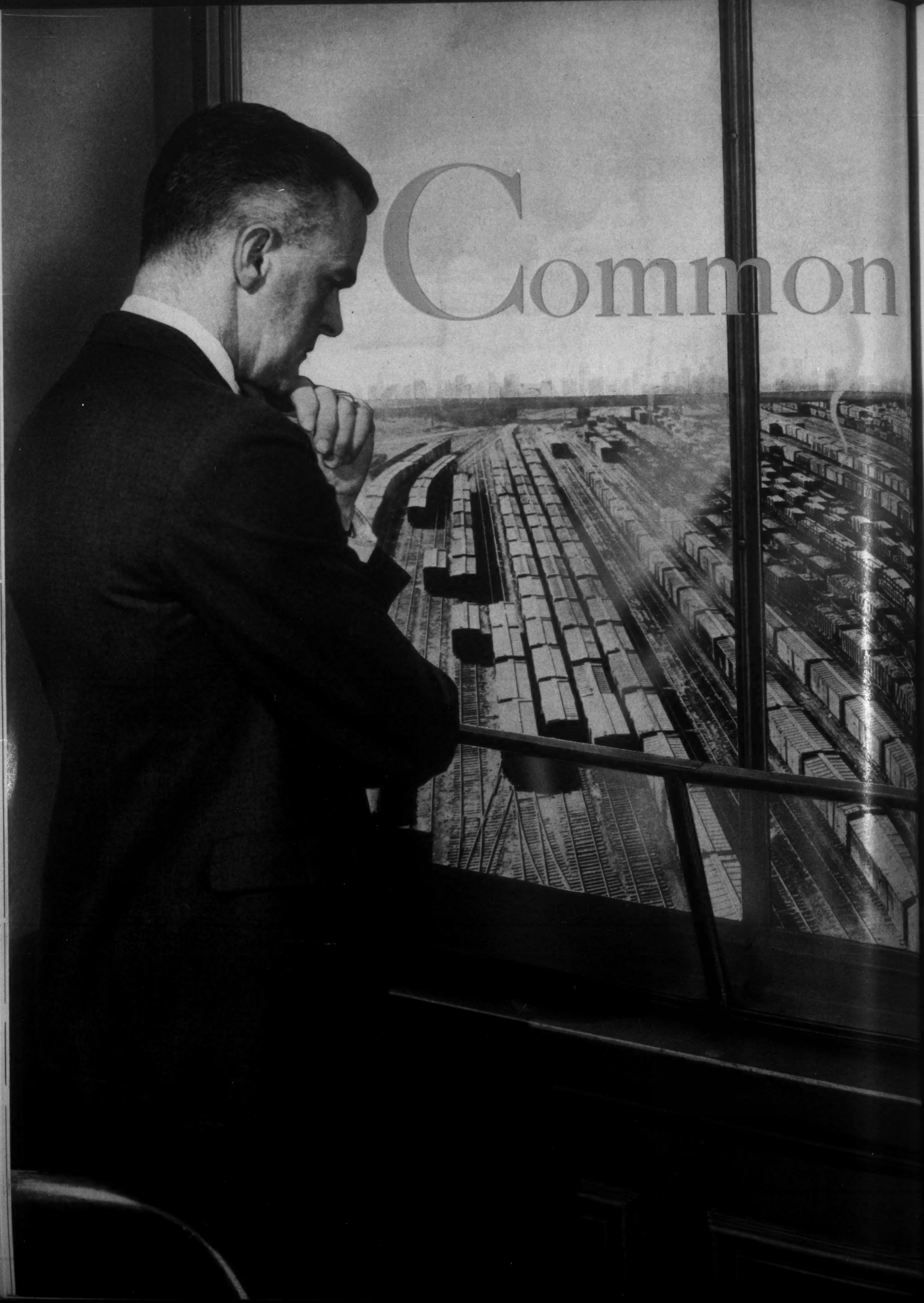

Common

1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Golden Cycle Mill Serves Cripple Creek Well. Max W. Bowen. *Engineering & Mining Journal,* Vol. 136, Aug. 1935, pages 381-385. The custom plant of the Golden Cycle Corp. at Colorado Springs has roasting, cyanidation and concentrating facilities and besides handles complex Au-Ag ores from other districts. Flowsheets are shown for the sampler, for average-grade ores, for low-grade ores, and for complex ores containing Au, Ag, Pb, Cu and Zn. WHB (1)

Reconstruction and Expansion of the Krasnouralsk Ore Dressing Plant (Russia). E. I. Elitenko. *Tzvetnuie Metallui,* Apr. 1935, pages 30-50. Part 2 (see *Tzvetnuie Metallui,* No. 9, 1934). A detailed description of the improvements and new construction of the Krasnouralsk Ore Dressing Plant. BND (1)

■ 1b. Gravity Concentration ■

Recovering Gold from Copper Mill Tailing. E. W. Engelmann. *Mining & Metallurgy,* Vol. 16, Aug. 1935, pages 331-332, 337. Discusses the recovery of Au from Cu mill tailing by use of burlap in bottom of launders at the plant of Magna Mill of Utah Copper Co. Practically all of the Au was recovered in the first 1000 ft. of burlap. Net saving per year proved sufficient to construct the plant. The new plant treats about 12000 tons of tailing per day. Practically 75% of Au is in concentrate from first set of launders. Product from each launder is screened, weighed and sampled separately. VSP (1b)

Mining and Milling at Broken Hill, Australia. M. W. von Bernewitz. *Mining & Metallurgy,* Vol. 16, July 1935, pages 289-293. Broken Hill lode has yielded 47,000,000 tons of ore. It consists of sulphides of Pb, Zn, and Ag with a gangue mainly of rhodonite and calcite. Methods of dressing the Pb-Ag-Zn ore are a straight flotation and a flotation plus gravity concentration. Metallurgical results are fairly similar, but there is a difference in cost. Describes the various plants at Broken Hill and their equipment. VSP (1b)

■ 1c. Flotation ■

Theory of Flotation (Zur Theorie der Flotation). Ian William Wark. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, June 1935, pages 265-283. Polemic discussion of the surface-adsorption and the linear-adsorption theory of flotation in which the linear-adsorption theory of W. Ostwald is elaborately refuted. ORS (1c)

Theory of Flotation (Zur Theorie der Flotation). Wolfgang Ostwald. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, Aug. 1935, pages 393-400. A condensed outline of the author's linear-absorption theory of flotation and polemic remarks about its criticism by Wark (*Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, June 1935, page 265). ORS (1c)

Remarks to the Papers: "The Theory of Flotation" (Bemerkungen zu den Arbeiten "Zur Theorie der Flotation"). Philipp Siedler. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 174, Sept. 1935, pages 73-76. Polemic discussion of the surface-adsorption and the linear-adsorption theory of flotation in favor of the former, with special reference to the papers of Wark (*Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, June 1935, page 265) and of W. Ostwald (*Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, Aug. 1935, page 393). ORS (1c)

Problem of the Mechanism of Flotation with Water-Insoluble Reagents (Zur Frage des Mechanismus der Flotation mit wasserunlöslichen Reagenzien. Die Rolle der unpolaren Phase im Prozess der Adsorption des Reagenz auf die Teilchen der Suspension) Z. W. Wolkowa, N. N. Serb-Serbina & A. W. Saporoshez. *Kolloid Zeitschrift,* Vol. 70, Mar. 1935, pages 323-328. A study of the 4-phase system water-nonpolar liquid-powder-air proved that the nonpolar phase (solvent of the reagents) plays an important rôle in the flotation process involving water-insoluble reagents. The hypothesis is set forth that the binding of the mineral particle through the air bubble represents a process of adhesion analogous to coagulation. EF (1c)

Flotation of Gold; Effect of Sodium Sulphide. E. S. Leaver & J. A. Woolf. *Progress Report—Metallurgical Division. 11. Studies on the Recovery of Gold and Silver. United States Bureau of Mines, Report of Investigations* No. 3275, June 1935, pages 23-38. Na_2S is an active depressant of clean metallic Au and does not aid the flotation of coated Au. The effect of Na_2S is more pronounced when ores comprised essentially of clean siliceous gangue are treated than with ores containing appreciable amounts of slime-forming minerals; apparently the slime absorbs part of the Na_2S. A 30 minute conditioning period preceding flotation decreases the effect of Na_2S on Au. Na_2S acts as a depressant for Au-bearing pyrite and Ag minerals. In general, flotation recovery of oxidized Cu and Pb minerals is improved by Na_2S; if such ores contain Au and Ag, these should be removed before adding Na_2S. AHE (1c)

I. Mono- and Poly-Molecular Sulphide and Hydroxide Films on Phase Interfaces. Experimental Investigation on Laminated Systems (I. Mono- und polymolekulare Sulfid- und Hydroxydschichten auf Phasengrenzflächen. Experimentelle Untersuchung über laminare Systeme) S. G. Mokruschin. *Kolloid Zeitschrift,* Vol. 70, Jan. 1935, pages 48-55. The significance of laminated systems (films) with reference to corrosion, physical property and flotation problems is pointed out. A study of the films of sulphides and hydroxides of metals which play an important role in certain flotation processes (sulphidizing of oxides) has been carried out. The significance of the color and metallic luster of films in relation to the structure theory of color and luster of coatings is considered. EF (1c)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

■ 2a. Non-Ferrous ■

Bismuth in Copper: Its Effects, Determination, and Some Experiments in Its Gaseous Elimination. C. O. Bannister & W. M. Doyle. *Bulletin of the Institution of Mining & Metallurgy,* No. 370, July 1935; pages 3-4. Discussion. See *Metals & Alloys,* Vol. 6, May 1935, page MA 178R/2. AHE (2a)

Recovery of Bismuth and Other Valuable Elements from Electrolytic Lead Slimes. N. Z. Singalovskii & E. P. Bogomil'skaya. *Redkie Metallui,* Vol. 4, Jan.-Feb. 1935, pages 24-30. In Russian. Air-dried slimes containing 50% Pb, 16% Bi, 7% Sb, 11% F, and 1.24% Ag were roasted with $CaCl_2$ at 340 to 370°. The sintered mass was then treated with a saturated solution of $CaCl_2$, thereby extracting the Pb, Ag, and small amounts of Cu present. The Ag was precipitated from the solution with Na_2S, after which Pb was also recovered. The sinter residue containing Bi and Sb was then treated with HNO_3 (sp. gr. 1.2) to dissolve the Bi. According to the authors, about 94-98% of the Pb, Bi, and Ag was recovered. HWR (2a)

Production of Magnesium by the Electrolysis of Its Oxide in a Solution of Fluoride Salts. V. P. Pavlov & V. E. Ivanova. *Legkie Metallui,* Vol. 4, Mar. 1935, pages 21-30. In Russian. The m.p. and solubility of MgO in the systems BaF_2-NaF and $CaF_2.MgF_2$-NaF were investigated. In no case does the solubility of MgO in these systems exceed 0.2%. In the electrolysis of MgO, the proportion of MgF_2 in the electrolyte must be sufficient to form the compounds $BaF_2.MgF_2$ and $NaF.MgF_2$; otherwise Na will be deposited. Electrolysis of Mg from these solutions was difficult because of the frequent "anode effect." HWR (2a)

Extraction of Vanadium from the Basic Open-hearth Slag of Titano-magnetite Ore of Ural. J. M. Krasnokutskiy. *Zhurnal Khimicheskoy Promishlennosti,* Vol. 12, Mar. 1935, pages 281-284. Roasting basic open-hearth slag in the rotating furnace with 25-30% soda for 2-3 hrs. at 820°-850° C., followed by leaching with water for 1 hr. gives 80-85% extraction of V from the slag. The precipitation of V with Ca makes it possible to separate the Cr. The precipitated Ca vanadate contains 25-32% V_2O_5 from which it is possible to prepare high percentage ferro-vanadium. NA (2a)

Copper Mining and Smelting in Germany. O. Bertoya. *Metallurgia,* Vol. 12, Oct. 1935, pages 165-168. Describes Cu mining area, methods of mining, smelting, and refining at the Mansfeld works at Harz mountain. JLG (2a)

Rational Preparation of Copper Smelter Charge. G. Ya Leizerovich. *Tzvetnuie Metallui,* Apr. 1935, pages 75-91. Results of experiments showed advantages of the use of finely ground quartz flux (less than 1 mm.) and its proper mixing with the charge of Cu concentrates. BND (2a)

Bismuth in Copper: Its effects, Determination, and Some Experiments in Its Gaseous Elimination. C. O. Bannister & W. M. Doyle. *Metal Industry,* London, Vol. 46, Jan. 18, 1935, pages 96-99, 102; Jan. 25, 1935, pages 125-128; Feb. 1, 1935, pages 145-147; Feb. 8, 1935, pages 171-172, 179. See *Metals & Alloys,* Vol. 6, May 1935, page MA 178R/2. HBG (2a)

Modernizing the World's Largest Lead Smelter. A. B. Parsons. *Mining & Metallurgy,* Vol. 16, Sept. 1935, pages 375-379. Describes modernization of Broken Hill Associated Smelters Proprietary, Port Pirie, South Australia. Capacity of plant for smelting and refining is 220,000 short tons of Pb/yr. Major changes made were: (1) erection of central electric power station; (2) introduction of electric locomotives and automobile trucks; (3) installation of traveling electric cranes; (4) overhead electric telpher system; and (5) development and introduction of a continuous process for refining Pb bullion. Includes flowsheets of smelting and refining departments. VSP (2a)

■ 2b. Ferrous ■

A Review of Blast Furnace Development in the U.S.S.R. B. M. Suslov. *Iron Age,* Vol. 136, Aug. 1, 1935, pages 12-17. Discusses the growth of Russian blast-furnace practice, presents current developments and what may be expected in the future. Pig Fe output rose from 4 to 10 million tons in 5 years. Introduction of large sized furnaces with a volume of 930 $m.^3$ paved the way for transition to blast furnaces having a volume of 1180 $m.^3$ and average daily production of from 1,000 to 1,100 tons. VSP (2b)

The Direct Production of Steel in the Blast Furnace. M. Fränkel. *Iron & Coal Trades Review,* Vol. 131, Oct. 4, 1935, pages 545-546. The process described first in *Stahl und Eisen* as used for phosphatic ores is explained and discussed. The advantage of the new process is the continuous production of finished steel from a blast furnace plant in which the heat of oxidation of P and, to a lesser extent, of Mn is utilized to reduce molten FeO to Fe. The process is compared with the Krupp process for siliceous ore. The new process is considered more advantageous as the steel is delivered molten and free from impurities while the older method produces an incoherent mass which requires careful subsequent refining. The only unfavorable feature is the necessity for briquetting the ore. Ha (2b)

3. MELTING, REFINING AND CASTING

Foundryman's Reference Book. Jas. F. Bowe. Revised by A. A. Grubb. Albany Sand & Supply Co., Albany, 1934. Fabrikoid, 3¾ x 6 inches, 219 pages. Price $2.00. The original edition was compiled by Jas. F. Bowe in 1927 and this edition was revised by A. A. Grubb. This book presents in convenient, brief and condensed form, tables, rules, formula and other data of value to the foundryman. A considerable amount of material is taken from the publications of the American Foundrymen's Association.

In the front of the booklet, 24 pages are devoted to advertising of the company. Then a brief outline of foundry sand and clay technology by Grubb; and Moisture and Bond Control by L. H. Marshall. Richard Rimbach (3) -B-

A Glimpse at the Foundry of 1950. Fred J. Walls. *Foundry,* Vol. 63, Aug. 1935, pages 47, 90, 92. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 389L/1. VSP (3)

American Foundry Industry (Aus der amerikanischen Giessereiindustrie). E. Piwowarsky. *Giesserei,* Vol. 22, Oct. 11, 1935, pages 511-514. Discusses and compares methods of sand testing and molding with German practice. Ha (3)

Gas Bubbles in Castings with Particular Consideration of Cast Steel (Gasblasen in Gussstücken unter besonderer Berücksichtigung von Stahlguss). Knipp. *Giesserei,* Vol. 22, Oct. 11, 1935, pages 505-511. Origin and behavior of gas bubbles in liquid metals were investigated. Gases in the melt and gases originating from the molding material can cause pinholes in the skin and pinholes in castings, the same effect can be produced by gases entering into and escaping from the metal. The cooling conditions have an important effect. Gas bubbles may wander away from the point of their origin and be trapped in the metal at another place. Even very tiny gas bubbles in a specimen may cause quite a difference in the result of the tensile test. Formation of gas bubbles in the molding process can best be avoided by using a molding material which will evolve very little gas; a sand binder is the more dangerous the greater its evaporation velocity at the pouring temperature. Ha (3)

3a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Centrifugal Casting of Non-ferrous Metals (Schleuderguss von Nichteisenmetallen). H. Ludwig. *Giesserei,* Vol. 22, Aug. 30, 1935, pages 428-434. The historical development of centrifugal casting is briefly outlined, principles and theoretical fundamentals are explained, and applicability for metals discussed. Practically all metals from Al to Pb can be cast centrifugally: bronzes, in particular those with high Pb content, are sometimes difficult to handle as they have a tendency to dissociate. This can, to a certain extent be prevented by a Ni addition, but it is expensive. Practically all shapes of castings are now centrifugally cast. Patented methods are reviewed. Ha (3a)

Casting Study on Commercial Crude Zinc (Giessversuche mit Hüttenrohzink). Josef Klärding. *Zeitschrift für Metallkunde,* Vol. 27, Apr. 1935, pages 93-94. Zn cast in horizontal cakes forms coarse vertical columnar grains, while Zn cast in vertical molds forms coarse columnar grains which grow outward from the walls of the mold and meet in a well-defined surface through the center of the ingot. The latter type of ingot is subject to cracking at the center. An investigation failed to reveal the presence of any eutectic material at the central boundary, and it was concluded that the cracking results from the grain structure alone. To remedy the defect a fine grain is desired. Zn has a high crystallization velocity and a low capacity for nucleus formation. Therefore slow freezing is to be desired in order to give time for nucleus formation, but the rate must be fast enough to prevent excessive grain growth. The casting conditions recommended are: (1) metal temperature 470° C. and (2) mold temperature 300° C. FNR (3a)

Manufactures Plumbers' Supplies. *Foundry,* Vol: 63, July 1935, pages 24-25, 66, 68. Describes the foundry of the Hays Manufacturing Co., Erie, Pa. VSP (3a)

Change in Molding Method Reduces Cost of Lead Saucer Castings. John H. Eastham. *Iron Age,* Vol. 136, Aug. 15, 1935, pages 20-21; 96, 98. Foundry receiving orders for denitrating tower Pb saucer castings has for a considerable time swept the saucer molds up in loam. Cost of production was lowered and more satisfactory margin of profit obtained by changing to open-sand molds which are described. VSP (3a)

Metal Melting—Its Effect on Quality. H. W. Brownsdon. *Journal Institute of Metals,* Vol. 57, Sept. 1935, pages 419-432 (Advance Copy No. 714) Autumn lecture of the Institute of Metals, delivered Sept. 9, 1935. A general discussion of the influence of melting on the quality of non-ferrous metals. Factors influencing quality are grouped under the headings of raw material, contamination, and refining during melting. The lecture was to serve as an introduction to a discussion on the subject. JLG (3a)

Refining Bismuth. C. C. Downie. *Electrical Review,* Aug. 30, 1935, page 278. In electrolytic production of pharmaceutical Bi from Pb, crude Pb is first smelted and cast into anodes, care being taken to see that all Bi passes into Pb. Anodes are transferred to tarred wood tanks, being suspended alternately with cathodes in the same manner as for the multiple system of Cu refining. Cathodes, of refined Pb, are longer and wider than corresponding anodes. Electrolyte, composed of $PbSiF_6$, is circulated through tanks by gravity, contact with air being avoided. Frequent additions of H_2SiF_6 are necessary. Anode sludges are washed in H_2O, dried, mixed with fluxes, and cast into fresh anode bars. During this refining, the As and Sb must be eliminated. Separation of Bi is performed in a manner similar to the first part of the process. Cast anode must possess the desired surface, and a comparatively pure fluo-silicate solution must be maintained during electrolysis. By manipulating current density and the conditions, the Pb is made to remain in solution without deposition, while the small proportion of Ag remains undissolved in the slimes. Bi deposited cathodically is dense and compact. MS (3a)

Advances in the Melting and Casting of Non-Ferrous Metals. R. Genders. *Metal Industry,* London, Vol. 46, Jan. 11, 1935, pages 55-58, 77. The various defects, now fairly well-known, which arise in castings and rolled material may well be grouped under the general term of unsoundness and nearly all are caused by some type of metallic cavity containing either gas or non-metallic matter. Oxide-inclusions and the dissolved gases, formed during the melting period, can now be eliminated by methods developed for proper deoxidation and degasification which produce both forged and cast alloys with improved mechanical properties. The functions of fluxes and deoxidizers have been studied and are now used scientifically instead of empirically and have assisted in the improvement of the soundness of the product. Electric melting has aided in the quantity production of a more uniform product. It is predicted that electric melting, with the interior of the furnace evacuated, will probably soon provide materials of a still higher quality and purity. The Rohn vacuum melting equipment is briefly described. Some of the problems of casting, such as unsoundness due to occluded gases and shrinkage cavities are not completely solved. Modifications of the Durville process are suggested for elimination of the occluded gases. Mention is made of other improvements which are now used to minimize casting defects. Vacuum melting and the RWR process are listed as methods in the experimental stage that look promising. Mention is also made of the recently announced process whereby molten metal is cast directly on the rolls for the production of strip. HBG (3a)

Use of Permanent Molds in Bronze Casting (L'Emploi des Moules permanents dans la Fonderie de Bronze). Henri Marius. *Cuivre et Laiton,* Vol. 8, Sept. 30, 1935, pages 403-407. Advantages to be gained more easily by the use of permanent molds on bronze are a 10% increase in elastic limit, 15-20% in ultimate strength and 10% in Brinell hardness. Methods of pouring (from above and below) and its influence on the casting, and the wall thickness of the molds are discussed. For the latter, a formula is developed: $E = 2.7P(Tc\text{-}Td)/Lt(1.8T + 32)$, where E is the wall thickness of the mold in mm., P the weight of the casting in g., Tc the temperature of pouring the metal in °C, Td the temperature at which the casting is removed, L the greatest dimension of the casting, t time in minutes during which the casting remains in the mold before removing, T permissible increase of temperature of the mold under the influence of the heat furnished by the cast piece. The material of the mold should be a hard cast Fe of fine grain with total C 3-3.25%, combined C at least 0.70%, Si 0.8% max., S 0.15% max., Mn 0.55-0.80%, P 0.40%. Ha (3a)

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CAST IRON
SPECIAL FLUXES FOR
SPECIAL ALLOYS

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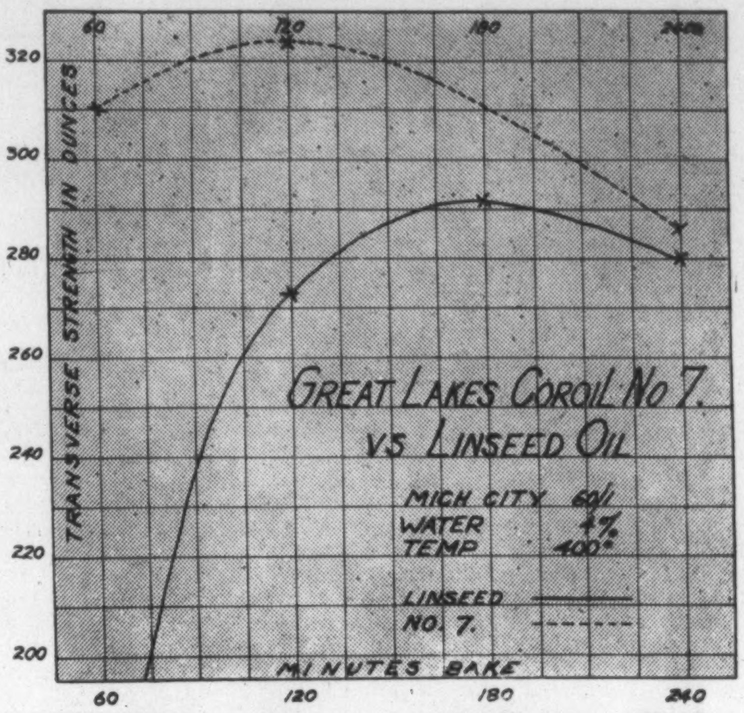
The Die Casting of Non-Ferrous Metals. Yellow Metals; Zinc Base Alloys and Aluminum Alloys. *Metal Industry,* London, Vol. 46, Jan. 11, 1935, pages 59-65. (I) **Die Casting in Yellow Metals.** A. H. MUNDEY, pages 59-61. Two classes of yellow metal alloys are discussed as having been established as satisfactory die casting materials. They are (1) Al bronze and (2) high tensile brass. Under (1) are included as being in general use (a) 90 Cu, —10 Al and (b) 88 Cu, 9 Al, 3 Fe. Ni and Mn are sometimes added. The mechanical properties are given. It is stated that these properties are enhanced by heat treatment. The method suggested is: quenching in water from 850°-900° C., reheating to 600°-650°, which increases the strength and hardness but decreases the ductility. The following desirable properties are recognized for this alloy; accuracy, resistance to corrosion and to rusting, resistance to shock, heavy loading and fatigue stresses, permanency and electrical conductivity. In addition, a method of soldering is outlined. Under (2) are included the Cu-rich brasses of the nominal composition 60 Cu-40 Zn. Included are Muntz metal, Mn bronze, and a number of proprietary brasses. Casting technique is made difficult by the evolution of ZnO during casting. The Polak process is briefly discussed. A comparison of the physical properties of some of the alloys used is appended. (II) **The Zinc Base Die Casting Industry.** D. KIRKWOOD, JR., pages 61-63. The necessity of using high purity Zn as the basis of work is emphasized and 5 examples are listed where the influence of Sn and Pb on the impact strength of the alloy are shown. Close control of the alloy is the dividing line between satisfactory and unsatisfactory castings. Applications of Zn base die castings are increasing in number. (III) **Aluminum Die Castings.** FREEMAN HORN, pages 63-65. Al die castings usually contain Si and/or Cu, and these have certain well-defined advantages which give to Al die castings an important place in the foundry industry. The different types of castings discussed are pressure die castings, gravity die castings, slush castings and centrifugal castings. The advantages of Al-base die castings are lightness of the alloy combined with high tensile strength, resistance to corrosion and good behavior at high temperatures, dimensional stability and permanence of shape. The alloys generally used are the Al-Si alloys, the Al-Cu alloys, and the Al-Cu-Si alloys. The advantages of these different groups are discussed. The effect of heat treatment is commented upon and "modifications" of the Al-Si alloys, by treatment of the molten metal by elements such as Na, are also considered. HBG (3a)

The Doehler Brass Casting Process. C. R. NORWOOD. *Metal Industry,* London, Vol. 46, Jan. 18, 1935, pages 91-95. This process is a highly developed type of plate molding which, it is claimed, gives a product superior to any that can be obtained if sand is the molding material used. Molds are made of a mixture of 1 part plaster of Paris and 2 parts of asbestos with sufficient water to make a consistency of thin cream which is poured on the pattern or matchplate. The method used in making the patterns and molds is outlined. The necessity for care in drying the mold is discussed in detail and certain precautions to be observed when casting are indicated. The alloy recommended is 58% Cu, 40% Zn, and 2% Sn with a trace of Al which should give the following physical properties; 18¼ tons/in.² tensile strength, 12 tons/in.² yield with an elongation of 3½%. It is suggested that Al- and Mg-alloys can be cast by this process and probably any other alloy that can be poured below 1700° F. HBG (3a)



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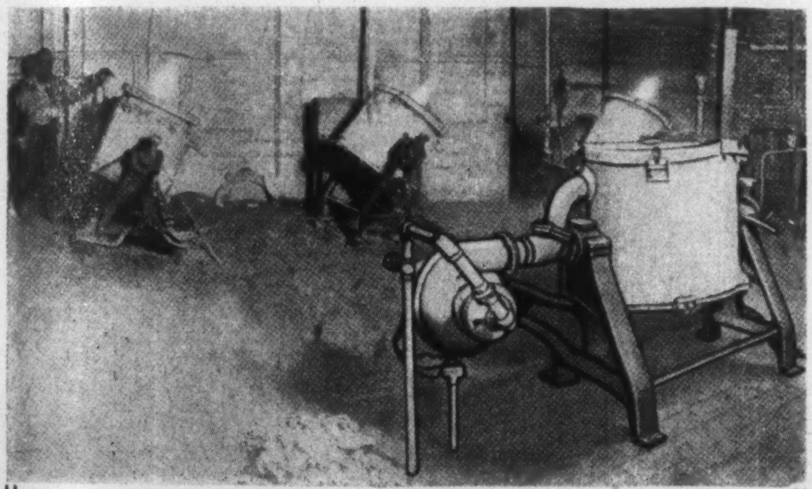

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C. H. HERTY, SECTION EDITOR

Sixth Report on the Heterogeneity of Steel Ingots. Joint Committee of Iron & Steel Institute, British Iron & Steel Federation, & Iron & Steel Industrial Research Council. *Iron & Steel Institute, Special Report* No. 9, Sept. 1935, 236 pages. Section I is an introduction describing the objects of the work and outlining the results reported. Section II—**The Examination of Further Ingots and Other Experimental Work by the Committee**, reports the standardized examination of ingots Nos. 63 to 69. These ingots were made by a variety of processes, including the basic-bessemer process. Section III—**The Origin and Formation of Inclusions**, by J. H. Andrew, T. Raine, & J. B. Vickers, briefly discusses the formation of inclusions and their determination in steel. Results by the iodine-extraction method and the vacuum-fusion method are then given for about 30 steel samples. The steels analyzed were made by a variety of methods. The O content calculated from the I residues were in fair agreement with the O determined by vacuum fusion. The apparatus used is described in detail. A furnace with a spiral C was used for fusion. The gas extracted was collected and analyzed for CO. Section IV—**A Critical Examination of the "Vacuum Fusion" Method for the Determination of the Total Oxygen in Steel**, by H. A. Sloman, describes the equipment used at the National Physical Laboratory and gives O analyses of 18 samples. The samples are melted in a special type of high-frequency furnace in which graphite powder is used for insulation. Excellent checks were obtained on duplicate analyses. The total O content for ingot 68 was approximately 0.0035%, while the total O content for this ingot as reported in the preceding section was approximately 0.012%. This difference is not commented on in the report. Section V—**Bibliography of the Determination of Oxygen in Iron and Steel**, by R. Elsdon, is annotated and contains 106 references. Section VI—**A Note on the Determination of Nitrogen and Some Results**, by T. Swinden & W. W. Stevenson, briefly discusses the influence of N in steel. Methods of analyses are then discussed and comparative results obtained by the Nessler method and the titration method are given. The checks were good. Nitrogen contents for a number of steels made by different methods are reported. The N content of both acid and basic open-hearth steels was in the neighborhood of 0.004% and that of acid and basic bessemer steels in the neighborhood of 0.015%. Section VII—**Bibliography on Nitrogen in Iron and Steel**, by G. C. Lloyd, is annotated and contains 87 references on the effect of N and 22 on the analysis for N in iron and steel. Section VIII—**Some Experiments on Gases in Iron and Steel and Their Effect on the Solidification of Ingots**, by T. Swinden & W. W. Stevenson, describes 10- and 18-lb. ingots melted in a small high-frequency furnace. In the absence of C, say, 0.02%, O does not cause unsoundness. In the presence of C, O causes violent reaction during cooling. Passage of H through the melt causes unsoundness, N does not, H followed by N does not, CO a slight unsoundness and CO_2 no unsoundness. Section IX—**The Mechanical Properties of Carbon Steels Melted in Vacuo and in Certain Gases**, by J. H. Andrew & H. Elliss, gives results obtained with steels of different C contents. Tensile properties of these steels melted in vacuum and of the same steels melted in vacuum and then under H_2, N_2, and CO, respectively, at a pressure of 12 mm. of Hg are given. Melting under the different conditions influenced the mechanical properties appreciably even when changes in Mn and C contents were taken into consideration. Reasons for the changes are discussed. Section X—**Segregation in Steel Ingots**, by J. H. Andrew & E. M. Trent, contains data on the segregation in 55-lb. ingots from steels melted in crucibles and treated with either air, H_2, or N_2 just prior to casting. From these and other observations the authors conclude that gases are the real cause of the major segregation in steel ingots. According, to their theory, the gases liberated force out the impure liquid between the dendrites and tend to concentrate the impurities in the still-liquid metal. The influence of Al on segregation was studied. Section XI—**The Influence of Casting Temperature upon the Position of Blow-holes in Steel Ingots of Varying Oxygen and Carbon Content**, by C. A. Edwards, R. Higgins, M. Alexander & D. G. Davies, gives results obtained with small ingots of different O and C contents cast at different temperatures. The supposed O content was varied by first adding a standard amount of Fe_2O_3 and then adding different amounts of Al. The mechanism of rimming is discussed. Section XII—**The Constitution of Steel and the Influence of Differential Solidification upon Segregation in Steel Ingots**, by L. Northcott, discusses the possible compounds occurring in both solid and liquid steel. Segregation is then discussed and the major segregation is attributed primarily to differential segregation. This section contains a bibliography of 91 references. JLG (3b)

Cracks in Round Ingots. A. Yakhkind & N. Gotgelf. *Domez*, Nov. 7, 1935, pages 26-32. In Russian. Statistical method of K. Daeves was used for studying cracks produced in ingots of 500 open hearth heats. Straight C steel varying from 0.2 to 0.6% C was cast into round straight walled ingot molds without sink heads, having different diameters. Longitudinal cracks observed in the open hearth department were used as a criterion of quality. The percentage of defective ingots increased in direct proportion to their C content, speed of teeming and diameter of the ingot molds. The height of an ingot mold leads to a greater number of cracks in the metal cast under the same conditions. As the same teeming nozzle size was used throughout the whole checking period, the speed of teeming should correspond here to the teeming temperature. (3b)

Steel Castings with Special Reference to Alloy Steels. W. H. Hatfield. *Iron & Steel Industry*, Vol. 8, July 1935, pages 396-401; Aug. 1935, pages 426-429; *Foundry Trade Journal*, Vol. 53, July 18, 1935, pages 43-46; July 25, 1935, pages 69-71. Today excellent steel castings are produced in practically all the steels which have been developed; the ordinary high-tensile alloy steels, wear-resisting steels, steels of special magnetic properties, corrosion, and acid-resisting steels, heat-resisting steels and many others. A table gives some of the most important types of alloy steels, together with the mechanical properties which these steels possess in the condition they are usually put into service. A second table gives a summary of the typical applications of these various steels, together with an analysis typical of each case for the purpose of correlation. General hints for successful foundry technique are given and essential data needful for proper working out of foundry practice are presented. CEJ + AIK (3b)

Finishing the Heat of Steel. XXXV. XXXVI. J. H. Hruska. *Blast Furnace & Steel Plant*, Vol. 23, Sept. 1935, pages 619-620, 643; Oct. 1935, pages 701-702. Discusses square, slab, and polygonal ingots. Square ingots faces are mostly flat. In slab ingots, broad side usually measures from 1.1 to 2.4 times the length of the narrow side for big-end-down ingots and from 1.1 to 3.2 for inverted ingots. Pipe has same shape as ingot section but extends deeper into body. Straight-sided rectangle is most widely used as transverse contour. Broad sides are sometimes curved slightly. Inverted type is preferred for slab ingots. Polygonal ingots are used for high grade steels, the octagon and dodecagon predominating. Best results in yield and quality are obtained when there is a definite ratio between diam. of circumscribed and inscribed circles. For octagons, this ratio is close to 1.135. For corrugated sections, ratio is about 1.105 for decagons and 1.055 for dodecagons. Radius of curvature of fluted faces of larger octagonal ingots is about the same as the diam. of a circle inscribed to the octagon. For ingots up to 10 tons, radius should be 1.5 diam. For dodecagons, radius should be 0.4-0.5 diam. of inscribed circle. Advantages of polygonal ingots are less cracking, better surfaces resulting in lower chipping costs, more homogeneous and denser structure, and somewhat less segregation. Advantages of square ingots are slightly better yield and lower mold and production costs. Discusses round ingots. They are used exclusively for high-grade steels. Their advantages over square or polygonal ingots are uniformity of solidification and cooling for entire section, cleaner surface, and slightly lower mold cost per ton of steel. All surface defects are eliminated by turning the ingots over the entire length. Working costs are reduced when round objects are to be made from forging ingots. Round ingots can be teemed successfully in sizes up to 100 tons. Care must be taken not to use high pouring rates and cylindrical hot tops. Smaller sizes are usually bottom cast, while medium and large sizes are cast into gray Fe or sand molds. Slow pouring rate and low teeming temperatures are vital for good sand-cast ingots. Ample riser beginning near mold bottom facilitates bottom pouring or assures denser metal in central portion of ingot bottom. MS (3b)

The Thermal Stress of Steel Ingots During Cooling. Kotaro Honda & Tokutaro Hirone. *Bulletin Institute of Physical & Chemical Research, Tokyo*, Vol. 14, July 1935, pages 525-534, in Japanese; *Scientific Papers & Abstracts Institute of Physical & Chemical Research, Tokyo*, Vol. 27, July 1935, pages 39-40. In English. The thermal stresses of cylindrical ingots (radii 40 cm. and 80 cm.) and of spherical ingots (radius 40 cm.) caused by uneven cooling are calculated on thermo-elastic grounds taking the volume change due to the $Ar_{3\cdot1}$ transformation into account and assuming that the steel be perfectly elastic. The results of the calculation are summarized as follows: (1) When the condition is such that the transformation does not occur, radial stress is a compression, while in tangential and longitudinal stresses (for cylindrical ingots) the peripheral portion undergoes a tension and the central portion a compression. However, the $Ar_{3\cdot1}$ transformation changes their sign, and their magnitudes generally increase. (2) Consequently the residual stress should be greatly affected by the relative temperature of the transformation with regard to the lowest temperature at which the steel is practically elastico-viscous. (3) At the surface of the cylindrical ingot the amount of stress along the surface (the perpendicular component vanishes) is independent of its direction, while on the axis the longitudinal stress is twice as large as the stress perpendicular to it. WH (3b)

Steel Making in Relation to the Weld Rod Manufacture. T. Swinden. *Welder*, Vol. 7, Aug. 1935, pages 666-670. The effect of the metallurgical characteristics of the steel wire used in the form of electrodes on the quality of the weld is pointed out and the types of steel discussed which are most favorable for electrodes. Mild steel electrodes, particularly those intended for bare wire welding, and for rods in which cellulose material and acid slag are employed, are now preferably made of rimming steel the essential analysis of which is 0.15% C max., 0.60% Mn max., traces of Si, and S and P according to specification but usually not more than 0.05% max. Another type of steel used for weld rods is Si-killed mild steel made in the basic open hearth furnace. Treating the ingots to obtain uniform material, and processing the weld rods is described in full. Ha (3b)

Superheating Cupola Melted Iron. Garnet P. Phillips. *Foundry*, Vol. 63, Aug. 1935, pages 33-35, 72, 74. Gives results of tests on the effect of superheating a series of cupola melted metals in indirect arc rocking electric furnace. Series 1. Ni-Cr alloy—cupola mixture containing 20% steel, 37% pig Fe and 43% scrap Fe; Series 2. Contained small amount of Ni and Cr—cupola mixture contained 53% pig Fe and 47% scrap Fe; and Series 3. Ni-Cr alloy—cupola mixture same as series 1. Tests showed that superheating of cupola melted steel-mix alloy Fe, melted at high temperature in cupola is of no particular advantage except that of higher temperature. In case of plain Fe or very low alloy content Fe, made with pig scrap mixture in cupola, a decided improvement was found by superheating. Microscopic examinations showed little change in graphite size and distribution in alloy Fe but did show improvement in plain pig-scrap Fe of series 2. Includes table giving the chemical and physical properties of the metals. VSP (3b)

Thermodynamic Study of the Form of Silicon Dissolved in Liquid Iron (Étude Thermodynamique de la Forme du Silicum Dissous dans le Fer Liquide). F. Poboril. *Chimie et Industrie*, Vol. 31, Spec. No., Apr. 1934, pages 480-484. The influence of Mn on the constant K_{Si} and that of Si on the constant K_{Mn} may be explained by assuming the existence of silicates of Mn and Fe in liquid steel. The existence of FeSi in liquid steel has been found very likely by thermodynamic studies of the curves of solidification of the Fe-Si system proposed by Corson. The value of the 64.2 gram calories for the heat of fusion of pure Fe has been verified with the aid of the solidification diagram of the alloys Fe-V, established by Wever and Jellinghaus. MAB (3b)

Keeping Original Precision in Heavy Machine Tool Beds (La Conservation de la Précision d'Origine des Bancs de Grosses Machines-Outils). L. Prevot. *La Technique Moderne*, Vol. 27, Sept. 1, 1935, pages 573-578. Studies suppression of internal strains due to casting process in heavy machine beds. First part explains cause of the strains and how they are distributed through the members of the bed. Difference in cooling speeds of various parts of the bed can be avoided by using chill plates or by blowing air through tubes set at correct places within the mold. Another method is to avoid internal strains by a suitable heat treatment which is explained with help of charts. Last section is devoted to best way of setting beds in position in order to take account of length variations caused by temperature changes. FR (3b)

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The Distribution of Phosphorus Between Metal and Slag in the Basic Process of Steel Manufacture. E. Maurer & W. Bischof. *Iron & Steel Institute,* Advance Copy No. 12, Sept. 1935, 30 pages. A series of melts was studied in the laboratory to determine the distribution of P between metal and slag in the presence of pure Fe-phosphate slags, the effect due to SiO_2 and temperature being also examined. In the light of these results dephosphorization in actual steel-making processes is considered. The importance of the Mn content of the steel is emphasized. Production data on P removal are given and analyzed. A composite diagram is built up from which distribution of P may be inferred from the CaO and SiO_2 contents of the slag. Further sections deal with the dependence of P removal in the open hearth on temperature, and with the influence of MnO, MgO and Al_2O_3. 15 references. JLG (3b)

Further Notes on Open-Hearth Boils. Henry D. Hibbard. *Iron Age,* Vol. 136, Sept. 26, 1935, pages 98, 104, 108. Essential element of boil is the formation and escape of CO gas formed by oxidation of C in bath metal. Possible exception is when bath temperature is being lowered from excessively high point, in which case dissolved gases may escape even when no CO is being formed. Vigor of boil is measure of rate at which C is oxidized. To obtain a brisk boil, ore or other oxide of Fe must be added to slag. Gases which escape as boil are: (1) a part of those contained in charge; (2) those absorbed by melting charge; and (3) those formed by the reactions. At steel bath temperature any of the gases which cause boil expand to 5 or 6 times their volumes at atmospheric temperature. To insure suitable boil in making rimming steel bath metal should not contain too much Mn. This element tends to quiet the boil. Gaseous requirements for good ingot of rimming steel are a very small amount of H concentration and an adequate evolution of CO in the mold. VSP (3b)

Function of the Steel Foundry Foreman in Preventing Porosity. R. A. Bull. *Transactions American Foundrymen's Association,* Vol. 6, Apr. 1935, pages 375-393; *Foundry Trade Journal,* Vol. 52, May 16, 1935, pages 329-332. **Points to Causes of Porosity.** *Foundry,* Vol. 63, Jan. 1935, pages 19, 51-52; Feb. 1935, pages 33, 70, 72. Paper written mainly from the practical standpoint of regular production, not from the theoretical standpoint of scientific metallurgy. The author believes that the very nature of all the operations required for the manufacture of a steel casting are such as to introduce a greater number of potential hazards in respect to molds than in respect to metal. Comments are made regarding the influence of Al in forming inclusions. The author lists 25 possible causes for porosity which are generally controllable to some extent by the men responsible for making molds and cores, and pouring the steel. There is a very delicate balance which needs to be maintained between the combination of conditions that will prevent porosity and the combination of conditions that will cause porosity. CMS + AIK + VSP (3b)

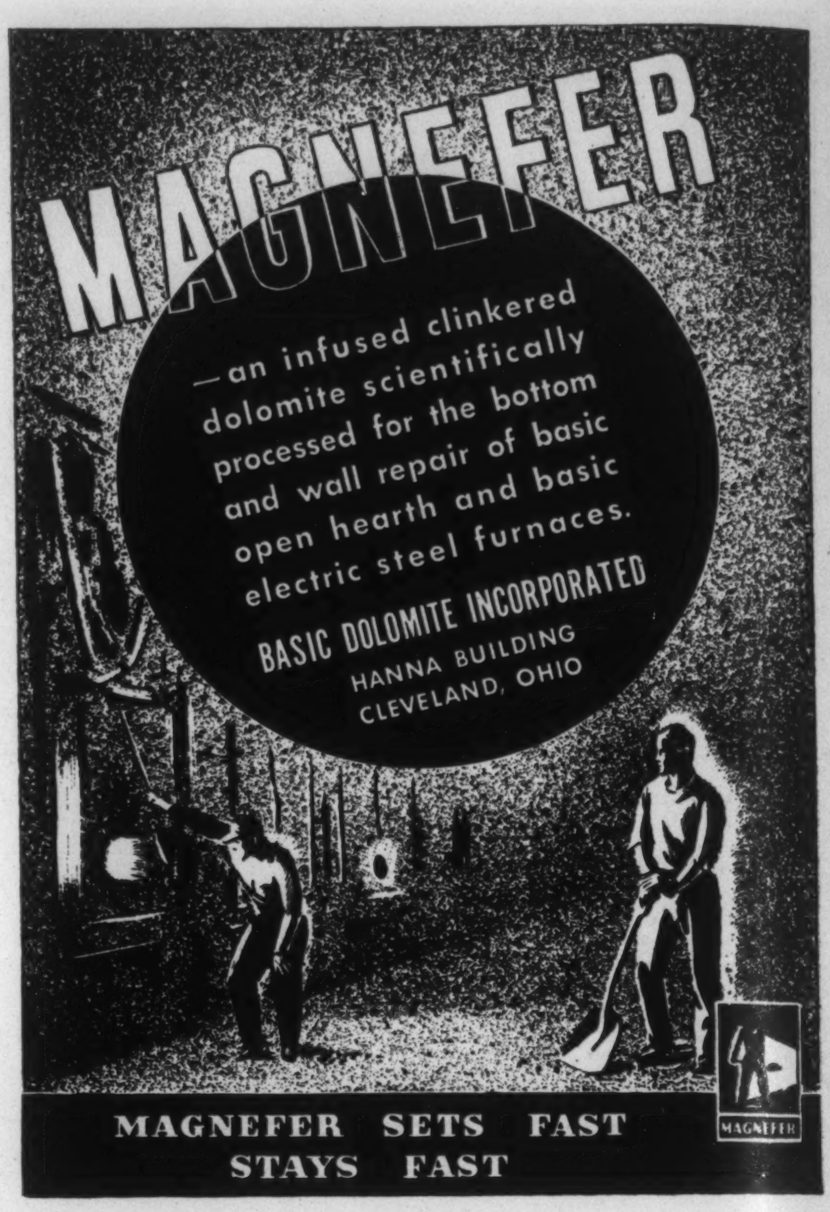
Slag Systems. R. Hay, J. White & A. B. McIntosh. *Journal West of Scotland Iron & Steel Institute,* Vol. 42, Mar. 1935, pages 99-103. The investigators record some results obtained by heating binary mixtures of MnO and Al_2O_3 (up to 60% Al_2O_3) for the purpose of determining the constitutional diagram and the nature of the constituents present. A number of melts were sectioned, polished and examined by the microscope under reflected light. Experiments were also undertaken on ternary slags of the $FeO\text{-}MnO\text{-}SiO_2$ type, with reference to the reducing effect of C. The slags were heated with C and the pressure of the CO evolved was recorded. The activity of the slags in respect to C oxidation was found to be in the order: FeO, knebelite, fayalite and manganese silicate. Further experiments were performed, using small steel crucibles of 0.75% C content, to determine the degree of decarburization which occurred, and hence the effect of the slag on the iron carbide. FeO and fayalite were found to be the most active; MnO and rhodonite were comparatively inactive. GTM (3b)

Melting Manganese Steels for Tractors in Basic Furnaces. P. W. Umrikhin & L. S. Epstein. *Metallurg,* No. 1, Jan. 1934, pages 39-47. In Russian. Analysis of steels: 0.1-0.38% C; 0.20-0.35% Si; 1.2-1.9% Mn; 0.5% Ni; $S + P < 0.1$. Two series of experiments were conducted in basic open hearths. In first series 4% Mn ore was given as a charge and no additions of either ferromanganese or Mn ore were made during the oxidation period. The final additions of ferromanganese were made just before tapping. The total loss of Mn (in slag as MnO and in furnace gases as Mn vapor) was about 75%. In the second series of experiments some ferromanganese and Mn ore were continuously added to the bath during the oxidation and refining periods, to keep Mn in metal around 0.3% and MnO in slag around 14-19%. The total loss of Mn in this case was about 20%. The following suggestions are given for melting practice: (1) keep MnO in slag around 16-18% both during the oxidation and refining period. Keep Mn in the metal above 0.3%, (2) it is better to make continuous additions of Mn and Mn ore during the whole course of the heat than to put them all in a charge, (3) because of high P content in the Mn ore, reduce P during oxidation period below 0.02%. VK (3b)

Refining of Ferro-Manganese in an Open Hearth Furnace. P. Kravtzov, S. Sapiro & I. Chernuishev. *Stal,* Vol. 4, Nov.-Dec. 1934, pages 94-101. In Russian. High-C FeMn can be decarburized in an open hearth furnace. In order to reduce loss of Mn by vaporization a deep bath should be used. The SiO_2 content in the slag should be a minimum. Fe ores should not be added, as Fe will reduce and thereby decrease the concentration of Mn. Dephosphorization can not be carried out simultaneously with decarburization. HWR (3b)

Production in the Basic Open-Hearth Furnace of High-Quality Steel for Deep Drawing. T. G. Grey-Davies. *Sheet Metal Industries,* Vol. 9, May 1935, pages 281-282. The author proposes a combination of the basic Bessemer and basic open-hearth processes as an aid in the production of this type of steel. AWM (3b)

Modern Equipment Features New Ford Foundry in Canada. *Foundry,* Vol. 63, Aug. 1935, pages 42-45, 86, 89. Describes new foundry of the Ford Motor Co. of Canada, Ltd. for the manufacture of alloy steel crankshafts. Five heats per day are melted in a single 9 ft. diam. furnace. Furnace charge is usually 11,000 lbs. Total daily melt is between 60,000 and 65,000 lbs. Of this the recovery is about 58.4% castings and 41.6% sprue, gates and risers. Castings are molded and poured in groups of 4 weighing 480 lbs. Anticipated analysis of metal in casting is: C 1.35 to 1.60%, Mn 0.60 to 0.80%, Si 0.85 to 1.10%, Cr 0.40 to 0.50%, Cu 1.50 to 2.00%, P 0.10% max. and S 0.06% max. Charge is 35% steel scrap and the rest pig Fe, return scrap and alloys. VSP (3b)



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Permanent Mold Castings. F. J. WALLS. *Transactions American Foundrymen's Association,* Vol. 6, Apr. 1935, pages 427-447. In the first part of the paper is described the development of the present permanent mold machines used by the company with which the author is associated. Comments are made on some of the fundamentals of mold design. Correct location of cavities, proper location of cores and vents, proper thickness of mold back, and good location of gates and risers are discussed. Assuming a good design, the mold will last from 3,000 to 10,000 pours. One of the most important problems in the successful production of permanent mold castings, is the balancing of pouring and cooling times. By means of a chart, the author shows that permanent mold castings are divided into four types, namely: cored castings of like sections; castings having medium thickness, hub, and rims, and light webs connecting the 2; castings with heavy hub, light spokes and heavy rim; and heavy cored castings. Melting practice and the structure and properties of irons obtained are discussed. A short resume of what has been done in the casting of alloy irons is given. CMS (3b)

Iron-Phosphorus-Oxygen System (Beitrag zum System Eisen-Phosphor-Sauerstoff). H. WENTRUP. *Archiv für das Eisenhüttenwesen,* Vol. 9, July 1935, pages 57-60. The constitution diagram of the system Fe_2O_3-P_2O_5 from 30 to 50.6% Fe was determined and of the system FeO-P_2O_5 from 46.9 to 59.8% Fe. It is shown that the compounds $Fe_2O_3 . P_2O_5$, $2Fe_2O_3 . 3P_2O_5$, and $3FeO . P_2O_5$ are stable up to the melting point. A diagram for the system $3FeO . P_2O_5—2Fe_2O_3 . 3P_2O_5$ is also suggested. SE (3b)

Value of an Iron Ore (Etude de la Valeur d'un Minerai de Fer). R. WINTGENS. *Revue Universelle des Mines,* Vol. 11, Oct. 1935, pages 434-441. A method is developed to determine the price at which the Fe ore used in the blast furnace process must be entered in the total cost and it is shown how the composition of the burden must be modified with changes in the tonnage of the Fe to be produced and with different kinds of ore. Balance sheets for the melting process are calculated. Ha (3b)

Ford Improves Quality and Cuts Costs by Casting Camshafts. *Iron Age,* Vol. 136, Aug. 15, 1935, pages 22-24. Success of cast camshaft depends on getting a structure with cam tip hard and center soft. As shaft is cast in green sand molds, depth of chill and strength of gray Fe core are dependent on analysis of metal, coke ratio, pouring temperature and amount of moisture in sand. Analysis of metal is as follows: C 3.30 to 3.65%; Si 0.45 to 0.55%; Cr 0.00 to 0.25%; Cu 2.50 to 3.00%; and P 0.05% max. Two standard cupolas are used. Pouring temperature is 2600° to 2650°F. Between each charge, on 8 hr. cycle, 125 lbs. of coke is added. Camshafts are impact tested by dropping a 3 lb., 8 oz. wt., 30 in. on center of main bearing. VSP (3b)

Modern Foundry Practice. Methods and Plant of John Harper & Co., Ltd. *Machinery,* London, Vol. 46, Sept. 5, 1935, pages 685-689. Descriptive review of cupolas, sand conditioning plant, hydraulic and pneumatic molding machines, core making with core blowing machine and the finish-shop where castings are sand blasted and fettled and some are finished by vitreous enamelling. WB (3b)

Contribution to Optical Temperature Measurement of Molten Iron and Steel (Beitrag zur optischen Temperaturmessung von flüssigem Eisen und Stahl). F. BLAUROCK. *Archiv für das Eisenhüttenwesen,* Vol. 8, June 1935, pages 517-532. A review of the literature is given followed by a discussion of the use of red and green filters in optical pyrometers; a correction method is described involving the use of first a green and then a red filter. The emissivity of molten Fe varies from 0.4 to 1.0 from oxide-free Fe to oxidized Fe, and with all gradations in between depending on the thickness of the oxide layer. In observations on cast-iron between 1360 and 1500° C. the oxide layer seemed to disappear at higher temperatures. The temperature of this transition seemed to be affected by the Mn and Si content of the Fe. SE (3b)

The Influence of Nozzle Refractories on Teeming Speeds of Ingots. A. JACKSON. *Metallurgia,* Vol. 12, Sept. 1935, pages 158-160. Influence of pouring speed on ingot is discussed. Clay nozzles erode away and give larger opening towards end of heat. A magnesia ring inserted in nozzle prevents appreciable enlargement of nozzle, but it is apt to cause spray during portion of pour. A new type of refractory recently used seems to offer promise. JLG (3b)

Operating Results with Terni Open Hearth Furnaces (Ueber Betriebsergebnisse mit Siemens-Martin-Oefen, Bauart Terni). O. GÖBL. *Stahl und Eisen,* Vol. 55, Aug. 15, 1935, pages 882-889. Operating data with this type furnace in several steel plants are given. SE (3b)

Investigation of Rail Steel from the Voikov Plant. V. DATTA. *Stal,* Vol. 4, Sept.-Oct. 1934, pages 31-44. In Russian. By means of frequency curves the relation between external defects on Bessemer rail steel and pouring temperature, length of blow, method of deoxidation, etc. is shown. The best pouring temperature was found to be 1400°-1410° C. and the optimum length of blow 45 sec./ton of steel. Deoxidation should be carried out with 75-80% Fe-Mn added to the converter, preferably molten or preheated to red heat. Due to the high Si content of the pig Fe used ($> 1.6\%$) it should be charged into the converter at a temperature of about 1160° C. After blowing, the steel should be held not more than 8 min. in the converter and 5 min. in the ladle before pouring. HWR (3b)

Calculation of the Metal Charges for the Foundry Cupola. H. L. CAMPBELL. *Foundry Trade Journal,* Vol. 52, June 27, 1935, pages 435-437. See *Metals & Alloys,* Vol. 6, May 1935, pages 107-112. AIK (3b)

Electric Furnace in Foundries and Steel Plants (Le four électrique à arc en aciérie et en fonderie). R. BOUTIGNY. *Journal du Four Electrique,* Vol. 44, July 1935, pages 251-255. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 318L/9. JDG (3b)

The Steel Processes Viewed in the Light of Available Raw Materials and Energy Supply (Die Stahlerzeugungsverfahren im Lichte der Stoff- und Energiewirtschaft). BANSEN. *Montanistische Rundschau,* Vol. 27, Aug. 1, 1935, pages 3-4. Review of a paper presented at the General Meeting of the Austrian Society of Iron Metallurgists, at Leoben, June 1, 1935. Discusses the replacement of iron ore by scrap iron, the effect of various impurities, and the advantages of the various types of smelting furnaces. BHS (3b)

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4. WORKING

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Modern Rod and Wire Mill (Neuzeitliches Stabstahl- und Drahtwalzwerk). L. WEGMANN. *Stahl und Eisen,* Vol. 55, July 11, 1935, pages 754-761. A large modern rod and wire mill is described with details on the roll tables and cooling beds. SE (4a)

Extension of Production and Sales of a Metallurgical Plant by Means of New Rolling Mill Installations (Extension des possibilités de production et de vente d'une usine métallurgique au moyen de nouvelles installations de laminoirs). WALTER NIETEN. *Revue de Métallurgie,* Vol. 32, July 1935, pages 273-281. Mechanical features of a light section and wire mill recently installed in France. JDG (4a)

Mill for Long Sheet of Light and Medium Gages (Walzwerk für starke Feinbleche und dünne Mittelbleche grösserer Längen). W. KRÄMER. *Stahl und Eisen,* Vol. 55, July 4, 1935, pages 732-736. A mill is described for rolling these sheets with one reheating. SE (4a)

Rolling Grate Iron. N. D. KRUPNIK & I. V. SHLEPKIN. *Domez,* No. 6, 1935, pages 70-71. In Russian. Grate bars having projections on one side only are rolled in specially designed rolls as continuous bars which are afterwards cut into individual grate bars. (4a)

Installation and Care of Roller Bearings in Rolling Mills, According to Vereinigte Kugellagerfabriken A. G. (Ausführung und Bewährung von Rollenlagern im Walzwerksbau, Bauart Vereinigte Kugellagerfabriken A.G.). W. JÜRGENSMEYER. *Stahl und Eisen,* Vol. 55, June 20, 1935, pages 670-680. Roller bearing design for hot and cold mills, discussing advantages of various types. SE (4a)

Design and Use of Roller Bearings (Allgemeine Grundlagen für Bau und Ausführung von Rollenlagern). W. JÜRGENSMEYER. *Stahl und Eisen,* Vol. 55, May 23, 1935, pages 557-564; May 30, 1935, pages 586-589. Design, frictional losses, lubrication, calculation of bearing loads, are discussed in detail. SE (4a)

Seamless Tube Manufacture. GILBERT EVANS. *Metallurgia,* Vol. 12, Aug. 1935, pages 113-115. Brief discussion of methods of producing seamless tubes. The machines discussed are Mannesmann, Stiefel, Evans, push-bench, Diescher, and Foren. JLG (4a)

Installation and Care of Roller Bearings in Rolling Mills (Ausführung und Bewährung von Rollenlagern, Bauart Timken, im Walzwerksbau). E. H. DOUGHTY. *Stahl und Eisen,* Vol. 55, June 27, 1935, pages 695-703. Design of Timken roller bearings is discussed and their advantages pointed out. SE (4a)

Deflection of the Rolls in Plate, Sheet and Strip Mills. J. SELWYN CASWELL. *Sheet Metal Industries,* Vol. 9, May 1935, pages 277-280. Paper read at the annual meeting of the Iron & Steel Institute in London, May 1935. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 354L/8. AWM (4a)

Influence of Roll Design on Appearance of Compressive Rolling Tears in Rods (Der Einfluss einiger Kalibrierungsarten auf das Entstehen von Druckfaltungsrissen bei Walzstäben). H. CRAMER. *Stahl und Eisen,* Vol. 55, July 25, 1935, pages 797-805. Roll design for avoiding rolling tears and seams in square, round, and oval bars is discussed. SE (4a)

Statistical Study on the Effect of Composition on the Sticking of Sheet (Grosszahluntersuchungen über den Einfluss der Stahlzusammensetzung auf das Kleben von Feinblechen). O. ANDRIEU. *Stahl und Eisen,* Vol. 55, Aug. 29, 1935, pages 925-930. The main causes of sticking are pressure, temperature, and composition, but irregularities in gage, roll alignment, rolling speed, skill of rollers etc. also play a part. Sheet lowest in alloy elements tend to stick most. A 0.05% Si content is hepful in overcoming sticking. SE (4a)

A Self Aligning Device for the Work Rolls of Four High Mills. J. H. HITCHCOCK. *Iron & Steel Engineer,* Vol. 12, June 1935, pages 354-355; *Iron Age,* Vol. 135, May 2, 1935, pages 37, 96; *Steel,* Vol. 96, Apr. 29, 1935, page 49. Describes method of mounting work roll bearing between parallel wedges so that misalignment causes endwise shift which brings the roll into alignment with its backing roll. WLC+VSP+MS (4a)

Roll Production. *Machinery,* London, Vol. 46, May 30, 1935, pages 253-259. The production methods in use by Sir W. G. Armstrong, Whitworth & Co., Ltd. for rolls used in iron, steel and non-ferrous industries. Melting, casting, pit furnace annealing and machining discussed and illustrated in photos. The various types of rolls are enumerated with sizes produced, hardness and the uses made of them. WB (4a)

Occurrences in the Parting Between the Rolls, Especially on the Location of Flow Layers and the Magnitude of Forward Slip in Rolling (Ueber Vorgänge im Walzspalt, besonders über die Lage der Fliessscheide und die Grösse der Voreilung beim Walzen). T. DAHL *Archiv für das Eisenhüttenwesen,* Vol. 9, July 1935, pages 15-21. What goes on in the space between the rolls was observed and formulae developed for the frictional and drawing conditions during rolling. These formulae work well in practice. SE (4a)

Oval Pass Design for Pilger Mills. P. T. EMELYANENKO. *Domez,* No. 7, 1935, pages 2-16. In Russian. Mathematical presentation of the conditions required for satisfactory operation of pilger mills using oval passes. (4a)

Study of Roll Design of Fassl Rolling Mill. A. P. CHEKMAREV, M. P. GALEMIN & I. P. NIKOLAETZ. *Domez,* No. 7, 1935, pages 56-63. In Russian. The mill is of a continuous type and has 7 stands rolling pipes from pierced billets. There are only 2 of these mills in Russia and none abroad. Checking individual passes showed that the mill works with a slight tension between the stands. (4a)

Design of Rolling Mills for Cold-Rolling Metals, Ferrous and Non-ferrous. C. E. DAVIES. *Iron & Steel Industry,* Vol. 8, Apr. 1935, pages 265-271, 274. Mill designer must be guided by theoretical knowledge of the mechanics involved and all deductions must be checked carefully by practical experience and experimental data. The chief action of rolls on metal is that of compression, and consequently the rolling mill may be looked upon as a continuous press which is self feeding. Tangential and horizontal components with frictional forces must also be considered. Theoretical principles involved in the cold rolling of metals are discussed. Types of mills are described. CEJ (4a)

The Deflection of the Rolls in Sheet and Strip Mills. J. SELWYN CASWELL. *Iron & Steel Industry,* Vol. 8, June 1935, pages 347-350. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 354L/8. CEJ (4a)

Composite Rolls. H. CRAMER. *Iron Age,* Vol. 136, Sept. 19, 1935, pages 28-29. Abstract translation of a report to the Verein deutscher Eisenhüttenleute, published in *Stahl und Eisen.* See "The Use of Roll-collars and Roll-collar Rolls," *Metals & Alloys,* Vol. 6, July 1935, page MA 278R/7. VSP (4a)

All Movements of Billet Gouger Controlled by Seated Operator. M. M. MCCALL. *Iron Age,* Vol. 136, Aug. 8, 1935, pages 18-19, 36, 38, 40. Describes construction and operation of an improved machine for removing seams and other defects from the surfaces of steel billets. It was built by the Niles Tool Works. VSP (4a)

Flexibility and Economy Achieved in Modernization of Niles Sheet Mill. F. L. PRENTISS. *Iron Age,* Vol. 136, Aug. 15, 1935, pages 26-28, 98, 100. Describes the modernization of manually operated sheet plant of Niles Rolling Mill Co. into a mechanized and highly flexible plant. Outstanding new equipment is a three-high roughing mill and a two-high finishing mill. VSP (4a)

The Effect of Some Mill Variables on the Gauge of Sheet Brass. C. K. SKINNER. *Metal Industry,* London, Vol. 45, Oct. 12, 1934, pages 343-344; Oct. 19, 1934, pages 369-370; Vol. 46, Feb. 22, 1935, pages 219-221. In addition to a brief history of the rolling process, a general description is given of the 3 main types of mills now being used, the 2-high, the 4-high, and cluster mills. The advantages and disadvantages of the different types are summarized. Consideration is given to variations in the cast or overhauled bars, the effect of oxidation from anneal to anneal, the effect of differences in temper of bars, the effect of bar width, the speed of rolling and the influence of the heat generated in rolling upon the gage of the finished sheet. It is shown that most of these variables have no appreciable influence on the gage of the finished sheet. However, it is pointed out that variations in temper outside the limits of one anneal cannot be accurately rolled in the same set, that it is more difficult to roll wide bars accurately than narrow ones, that the shapes of rolls may materially change the degree of flatness and straightness of the metal, that the greater the mass of the roll, the more accurate is the gage obtained and that lubrication seems to have an effect upon the end-to-end variation. HBG (4a)

Graphical Computation. F. M. SCHARFF. *Blast Furnace & Steel Plant,* Vol. 23, Sept. 1935, pages 611-615. Shows how graphical methods of computation work by giving examples of applications in the field of rolling steel. MS (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Steel Forgings and Drop Stampings. A. B. WINDER. *Iron & Steel Industry,* Vol. 8, May 1935, pages 331-334. Some of the more important aspects of heavy forging and drop stamping are considered from the standpoint of the steel itself. The ingot must be conceived as the genesis of the forging, and its production must be so controlled that the most perfect material is present in the parts which will ultimately carry the greatest stresses. In a drop forging the metal is forced, often at one blow, to flow into the space left between the dies and the fiber of the steel must necessarily flow smoothly and continuously throughout the mass. By skillful design of the dies the exact flow of the steel may be controlled so as to provide the closest knit structure in just those zones where the stresses are the most severe. CEJ (4b)

The Use of the Hele-Shaw Apparatus in the Investigation of the Flow of Metals. A. M. HERBERT & F. C. THOMPSON. *Iron & Steel Institute,* Advance Copy no. 8, Sept. 1935, 8 pages; *Iron & Coal Trades Review,* Vol. 131, Sept. 20, 1935, pages 430-434. A study of flow in wire drawing and in forgings together with flow observed in the Hele-Shaw apparatus showed that the apparatus could be used for studying the flow of metals in dies. 6 references. JLG + Ha (4b)

Hot Drawing Tubing Having Rectangular Cross Section. G. A. NEDELKO, G. P. PISCHIKOV & P. M. SHUVALOV. *Domez,* No. 7, 1935, pages 64-69. In Russian. Experiments in drawing tubing having rectangular section showed that in drawing directly through dies of either rectangular or oval and rectangular cross section either with or without filling the tube with sand the wider walls cave in. Drawing on a mandrel prevented wider sides from caving in but not the narrower sides. (4b)

■ 4c. Cold Working, including Shearing, Punching, Drawing & Stamping ■

Steel Wire. Manufacture and Properties. MAURICE BONZEL. Translated from the French by Kenneth B. Lewis. Engineers' Book Shop, New York, 1935. Cloth, 6½ x 10 inches, 495 pages. Price $15.00.

This is an English translation of Bonzel's book which appeared in French last year. It is the most extended treatment of wire manufacture and wire drawing that we have. It deals mainly with the European wet drawing process through a copper sulphate bath by which about 1,000,000 tons of wire are drawn annually in Europe, but it also covers "dry" drawing, as practiced in the United States. The owner and manager of a wire drawing establishment, Bonzel evidences an unusually broad knowledge of the science, lore, and practice of wire drawing. The wide range of his scientific interests are perhaps best illustrated in the illuminating and original discussion of lubrication and lubricants, but his treatment of the effects of cold work, the manner of deformation of the wire in the dies, etc., show equal insight and thorough grounding. After a very brief section on steel making for wire manufacture, there is a good treatment of the principles of wire drawing illustrated by wire drawing machines, a discussion of dies and die making, and the very good chapter on lubricants and lubrication already mentioned. The effects of cold work and aging are then discussed and the patenting and heat treatment of wire. In connection with the heat treatment of wire, there is an intelligent discussion of decarburization of high carbon wire during annealing, and how it may be avoided. Considerable space is devoted to actual layouts and plant data. The discussion of galvanizing is rather brief and does not give the impression of being fully up-to-date. The "galvannealing" process of electroplating zinc, followed by annealing to give better adherence of the coating is stated to have been tried but not to have proved very successful. Cadmium plating is dismissed in a page. The Tainton cleaning process is not mentioned. Altogether, only French and German practice, appear to have been considered. The main fault in the book, is that the viewpoint is so little from the standpoint of the user, but almost entirely from that of the maker. The discussion of the properties of wire and of wire quality would have been more significant if written from the angle of the uses to which the wire is put. An example of this is the section on corrosion which is very sketchy, and seems to hang in midair, divorced as it is from any mention of uses. Anyone interested in wire or wire drawing will certainly want to have access to this book. Let us hope also that it will stimulate someone to write a similar book on American practice. Samuel Epstein (4c)-B-

Cold-Heading Wire. L. D. SEYMOUR. *Wire & Wire Products,* Vol. 10, Sept. 1935, pages 414-418. The mechanics of cold-heading wire, the heat treatment to be given such wires, and the composition of steel used for such purpose are discussed and the desirable structure illustrated in micrographs. Ha (4c)

Effect of Drawing Die, Lubricant and Drawing Velocity on the Power Consumption in Drawing of Fine Wires of Steel, Especially in Multiple Drawing Machines (Einfluss der Ziehdüse, des Schmiermittels und der Ziehgeschwindigkeit auf den Kraftbedarf beim Ziehen von Feindraht aus Stahl, insbesondere auf Mehrfachziehmaschinen). ANTON POMP & H. HECKEL. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf,* Vol. 17, No. 8, 1935, pages 107-126. The tests with dies of Widia (tungsten carbide) showed that lubrication with soap is the best, while the power consumption was largest with rape oil lubrication. The most favorable angle for the die was 6°-9° for soap, and 9°-15° for drawing liquid and rape oil lubrication. The influence of both lubricant and die angle becomes less important with increasing section of the wire, and the efficiency improves. When using diamond dies, drawing liquid proved to be best (composed of 100 l. H_2O, 6 kg. rye flour, 2½ kg. beef tallow, 2½ kg. soft soap). Compared with Widia dies, a reduction up to 36% in power consumption was found, also with rape oil lubrication; while soap required higher power. The most favorable angle is smaller than for Widia dies. Multiple drawing arrangement resulted in a slight reduction of the drawing effort due to the back pull in the wire inherent in this drawing process. 26 references. Ha (4c)

Die Stresses and Die Wear. K. B. LEWIS. *Wire & Wire Products,* Vol. 10, Aug. 1935, pages 316-317. Some stresses which deform wire in the drawing process are discussed. They are ascribed rather to compressive stresses than to tensile stresses as other observers believe, and the improvement which could be obtained by applying a back pull on the wire is held due to the same effect as a ring cut into the die near the exit. Ha (4c)

Cold Work Action on Stainless Steel. RICHARD SAXTON. *Metallurgia,* Vol. 12, Aug. 1935, pages 119-120. Discusses drawing of wire from non-corrosive steels. JLG (4c)

A New Wire Drawing Mill [illegible] Neuartige Drahtbund-Förderanlage für Walzwerke). A. FLÜGGE. *Stahl und Eisen,* Vol. 55, May 9, 1935, pages 515-519. A new wire drawing mill is described giving very uniform structure and gage; the machinery and layout is compact requiring very little space. SE (4c)

Effect of Dimensions of Drawing Tools on the Results of Drawability Tests of Steel Sheet (Einfluss der Abmes[illegible]n der Ziehwerkzeuge auf das Ergebnis des Tiefungsversuchs bei Stahlblech). [illegible] TONN & W. PÜNGEL. *Archiv für das Eisenhüttenwesen,* Vol. 8, May [illegible], pag[illegible]514. Tests to determine the effect of the dimensions of the dra[illegible] to[illegible] and die) in the Erichsen and Guillery testing machines on the tes[illegible]us gages of deep drawing sheet indicated that the depth of draw in[illegible] the diameter of the ball and die. The effect of wear on the drawing [illegible] negligible. SE (4c)

Wire Manufacture, the Formation of Shapes. RICHARD SAXTON. *Iron & Steel Industry,* Vol. 8, Mar. 1935, pages 225-226. Due to the greater stresses imposed during the dra[illegible] operation, shape wires require more frequent heat treatment, material hard[illegible] up more rapidly than with the even pressure imposed during the formation [illegible]und. Shape wires cannot be drawn on continuous machines. While econ[illegible]ditions favor rapid reduction, high C steel, where required to withstand s[illegible] tensile stress as in wire drawing, does not respond efficiently to deformation [illegible] high speed. CEJ (4c)

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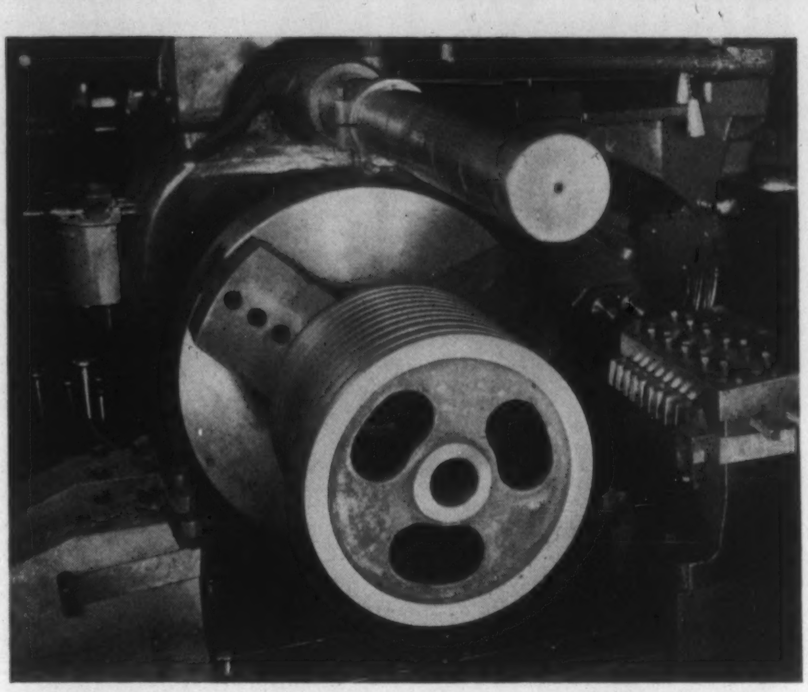

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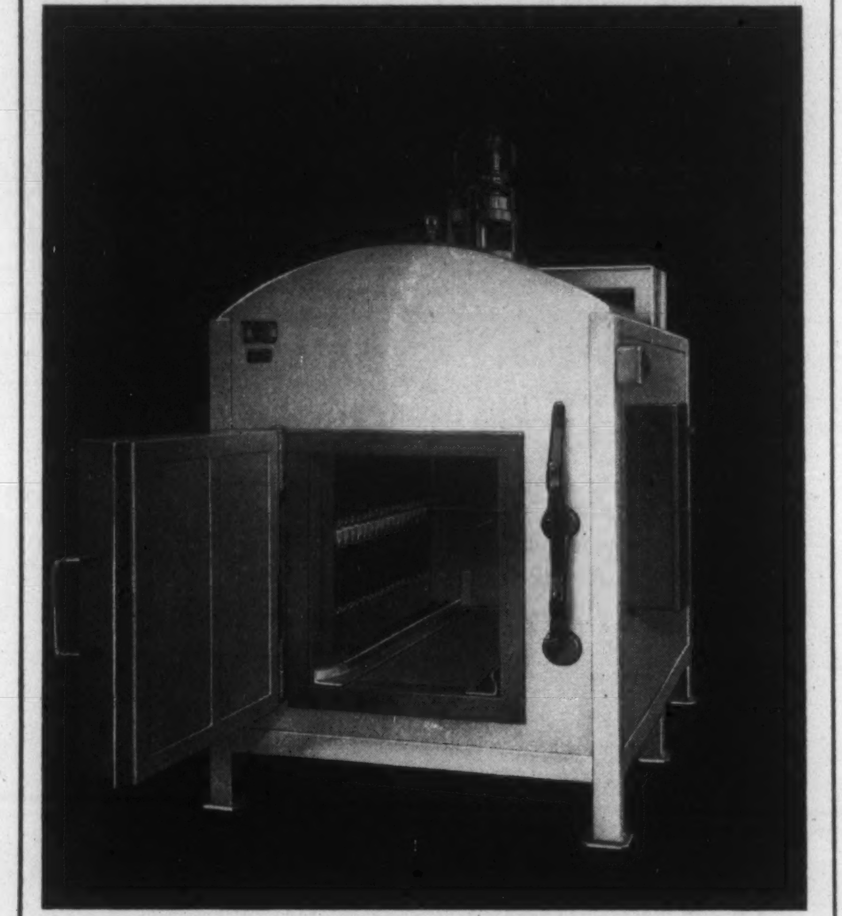

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5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Heat Treatment of Non-Oxidizing Steels (Traitements thermiques des Aciers inoxydable). PIERRE BEULOZ. *Metaux,* Vol. 9, Oct. 1934, pages 447-451. Martensitic steels can be grouped in 2 classes according to Cr content: 4-6% Cr and 12-14% Cr. Improvements in physical properties are obtained when 4-6% Cr steels are air-cooled from 850°-875° C. and reheated at 600° C. As an example a steel containing 0.2% C and 5.20% Cr after heat treatment showed the following results:

	Elastic limit kg./mm.²	Tensile strength kg./mm.²	Brinell Hardness
Annealed 850° C.	23	53	152
Quenched at 850° C.	80	148	417
Quenched at 850° C. and reheated at 600° C.	84	96	272

Addition of 0.5% Mo or of 1% W only slightly affects the physical properties at low temperatures but improves these properties at high temperatures. Titanium by virtue of its combining with carbon improves the resistance of steel to hydrogen under pressure. When Ti addition exceeds 0.7 to 0.8% the 4-6% Cr steels become ferritic. Steels with 12-14% Cr are oil quenched from 850°-875° C., followed by reheating and cooling in furnace. Reheating should not be done in the range 475°-600° C. because the steels are very much less resistant to corrosion after this treatment. This phenomenon is probably due to the carbide precipitation in the grain and at the grain boundaries. Ferritic Cr steels are those containing 18-20% Cr and 25-30% Cr. The 18-20% Cr steels are heat treated at 775°-800° C. and those of 25-30% Cr at 825°-850° C. followed by air cooling. The Ni-Cr austenitic steels are water-quenched from 1100°-1150° C. (1150°-1200° C. when Mo is present). GTM (5)

Heat-treating 1000 Different Parts. J. B. NEALEY. *Iron Age,* Vol. 136, July 25, 1935, pages 24-26, 82, 84. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 395R/2. VSP (5)

Commercial Heat Treating. A. M. STEEVER. *Industrial Heating,* Vol. 2, Sept., 1935, pages 541-544, 548. The importance of heat treating as part of metallurgical processes is generally discussed and furnaces and equipment of a heat treating plant are described. Ha (5)

Heat Treating Diversified Work on a Quantity Production Basis. J. B. NEALEY. *Machinery,* N. Y., Vol. 42, Oct. 1935, pages 108-110. Describes a modern heat treating department designed for economical handling of a large variety of work. Ha (5)

Progress in Heat Treatment of Alloys Resulting from Structure Studies. DAVID F. MCFARLAND. *Pennsylvania State College, Mineral Industries Experiment Station, Bulletin* No. 14, 1934, pages 67-76. General. AHE (5)

Monarch Company Revamps Heat-Treating Department. *Heat Treating & Forging,* Vol. 21, Oct. 1935, pages 496-497. **Tool Builder Installs Complete New Heat Treating Facilities.** *Steel,* Vol. 97, Sept. 9, 1935, pages 46-47. Describes heat treating department of Monarch Machine Tool Co., Sidney, O. MS (5)

■ 5a. Annealing ■

Box Annealing of Steel Sheets. ERIC R. MORT. *Iron & Steel Industry,* Vol. 8, Mar. 1935, pages 251-255. With modern design of furnaces in box annealing, the temperature gradient within the charge has been greatly reduced by attention to burner or port design and the position of the flues, giving the gases a better opportunity to heat the bottom of the charge. The practice for varying gages, the design of covers and charging arrangements are considered. Development work carried out with electrically heated sheet normalising furnaces indicates that certain definite advantages may be expected, so it may be that the future trend will be in this direction. CEJ (5a)

Sheet Normalising. ERIC R. MORT. *Iron & Steel Industry,* Vol. 8, June 1935, pages 367-370. Numerous advantages have been claimed for normalising as against box annealing, such as the elimination of heavy covers and bases and consequent saving in fuel costs and lower labor costs, quicker processing of material, greater uniformity of product and the possibility of controlling the grain-size within fine limits; on the other hand there are quite heavy installation costs and the maintenance cost to be considered. Modern furnaces 150 ft. in length and 96 in. in width have a capacity somewhat in excess of 8 tons/hr. The furnaces are usually fired with producer gas, the temperature of the sheets being brought up rapidly to 950° C. and cooled rapidly to below 700° C., in order to prevent grain growth. The design of the normalizer has yet to undergo many changes before it can be considered perfect, however, the greater uniformity of product is an important factor in the production of high grade bright annealed material. CEJ (5a)

■ 5b. Hardening, Quenching & Drawing ■

The Heat Treatment of Molybdenum Steel. A. J. HERZIG. *Industrial Heating,* Vol. 2, Oct. 1935, pages 569-574. The changes taking place in steel during the allotropic transformation and their importance for the heat treatment to be selected are discussed with particular reference to Mo steels. The normalizing, annealing, carburizing, quenching and drawing temperatures to be applied in order to get the best qualities out of the steel and the times which have to be allowed for the transformations to take place are given for Cr-Mo, Ni-Mo, Cr-Ni-Mo, Cr-Si-Mo, C-Mo, Mn-Mo and Mo high-speed steel (8-9% Mo). Ha (5b)

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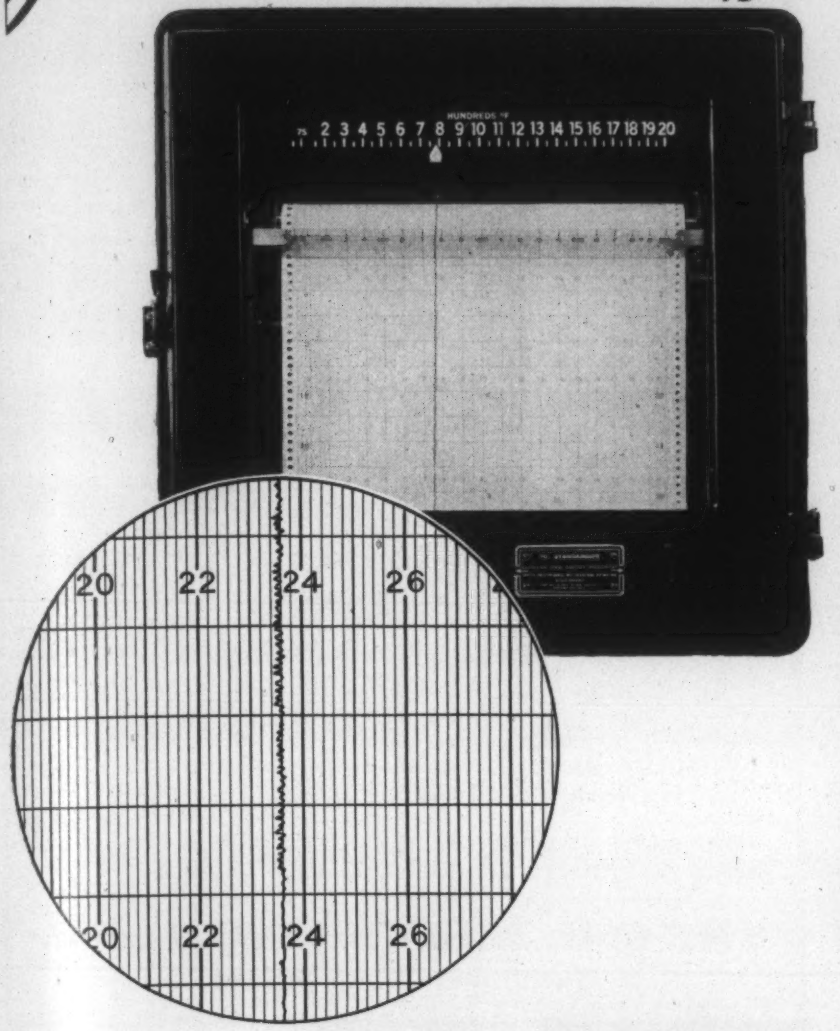

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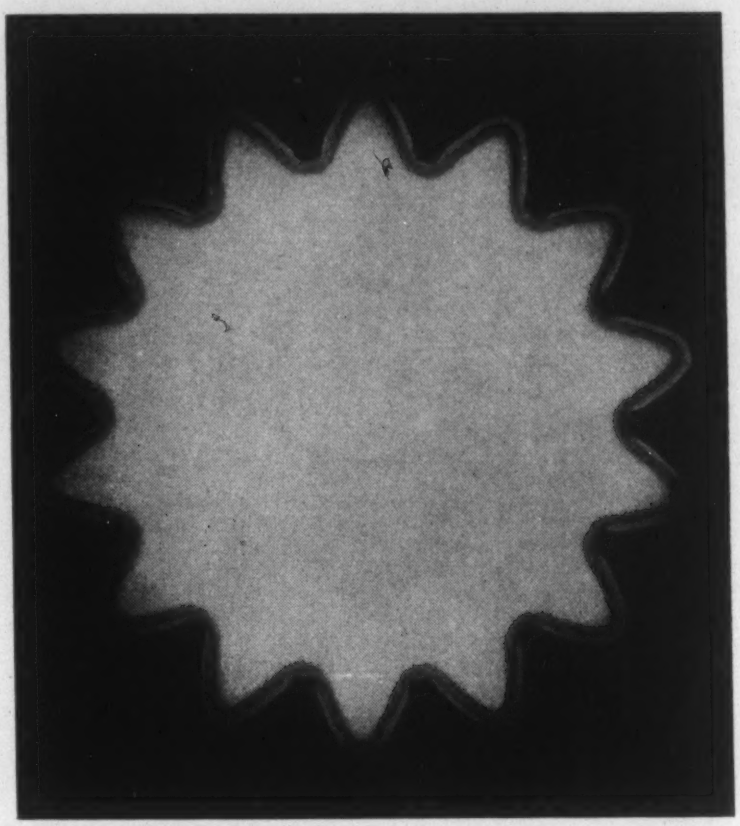

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■ 5c. Aging ■

Steel Parts are Carburized by Eutectrol Process. *Iron Age,* Vol. 136, Aug. 8, 1935, pages 24, 48. Describes process used by Auto-Lite Co. to carburize clutch pinions, bodies and housings, made from S.A.E. 4620 steel. Carburizing furnaces are batch type. Parts are given a case depth of 0.028″ at 1700° F. in 4½ hrs. Cycle consists of (1) Dx (reformed gas) flowing through muffle at 35 $ft.^3$; (2) Natural gas at 80 $ft.^3$/hr.; (3) Both Dx and natural gas at same rate for balance of cycle. Rate of C penetration is 0.012″/hr. VSP (5c)

■ 5e. Carburizing ■

Selective Carburizing of Steel. L. A. Lanning. *Industrial Heating,* Vol. 2, July 1935, pages 349-350. The methods of selective or local carburizing are discussed. Where plating equipment is available the parts are Cu plated all over and the plating is removed from the areas which are to be hardened. Where no plating equipment is at hand sand packing is employed, especially if holes are to be protected. Sometimes excess material is left which, after hardening the whole piece, is removed at the place to be desired soft. Ha (5e)

Tendencies and Developments in Case Hardening Practice. Henry Toplis. *Iron & Steel Industry,* Vol. 8, Sept. 1935, pages 483-486. The recent developments in case hardening have followed the urge for quicker or larger outputs demanded by mass production methods. Consequently there have been developments of standard methods rather than new discoveries. CEJ (5e)

■ 5f. Nitriding ■

Nitrided Tool Steels. Horace C. Knerr. *Iron Age,* Vol. 136, Sept. 26, 1935, pages 44-45, 96. Ordinary nitriding steels are available in bar stock, forgings and castings, and are used for a great variety of purposes where great surface hardness and wear resistance combined with strength, toughness and machineability in heat treated state are required. Steels for nitriding must be of special composition. Usually they contain about 1% Al but 0.50% V may be substituted. A much used nitriding steel is known as Nitralloy G. Heat treatment for this steel consists of quenching in oil or H_2O from 1700° F. followed by tempering in neighborhood of 1000° to 1100° F. Ordinary nitriding process consists in heating finished work at 950° to 1000° F. for 40 to 90 hrs. in sealed container through which anhydrous ammonia gas is passing. Work is then allowed to cool. Includes table giving the composition of nitralloy G steel. VSP (5f)

6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Heat Resisting Alloys. *Heat Treating & Forging,* Vol. 21, Oct. 1935, pages 485-487, 489; condensed in *Steel,* Vol. 97, Sept. 2, 1935, pages 41-42. A. O. Smith Corp. has developed an alloy, designated "Smith Alloy No. 10," for use as the heating element in electric furnaces and for other high temperature applications. It is composed of Fe, Cr, and Al with small amounts of other elements. Furnaces wound with this alloy operate safely at 2400° F. Some of the properties of the alloy are: electrical resistance, 1000 ohms/cir. mil ft.; m. p., 2830° F.; density, 6.9 g./cc. and coefficient of linear expansion, 12.0×10^{-6}/°F. between room temperature and 2400° F. It operates satisfactorily under oxidizing conditions. It can be welded to itself or to Ni-Cr alloy. An oxidizing oxy-acetylene flame can be used with a flux of ½ KCl and ½ NaF. It should not be shaped by grinding. It can be machined without difficulty, particularly if a milling cutter can be used, but it is better to avoid both grinding and machining. Discusses its possibilities in electric cooking ranges, and in laboratory, carbon combustion, ignition, assay, heat treating, melting, forge, general purpose, Cu brazing, and ceramic furnaces. MS (6)

Industrial High Frequency Power. H. V. NOBLE. *Electronics,* Vol. 8, Oct. 1935, pages 364-366. Presents the design, calculations, and wiring diagrams for a 20 kw. master oscillator controlled-tube converter for providing industrial power at 7 to 10 kilocycles. Converter was used for high frequency coreless induction furnace melting. It received its power from 220 volt, single phase, 60 cycle power line and delivered high frequency power at variable voltage (600 volts maximum in this design). This vacuum tube master-oscillator power-amplifier arrangement is compared with alternators, spark-gap converters, and self-excited oscillators. DJM (6)

Oil and Gas Fired Furnaces. R. BOYE. *Engineering Progress,* Vol. 16, Aug. 1935, pages 199-204. A few modern examples of fuel and oil fired box-type, forging, automatic hardening and salt or lead bath furnaces are described. Fuel costs and utilization of heat developed are compared for different fuels and with electricity as heating source. Ha (6)

Graphitization of Electrodes. B. M. STRUNSKI. *Domez,* No. 6, 1935, pages 48-58. In Russian. The purpose of this paper is to present the phenomena taking place during graphitization of electrodes in plant production. Detailed study of the changes in resistance, influence of different packing materials, voltages of the furnace and the temperature of the charge is presented. (6)

Use of French Refractories in Metallurgy (Utilisation des refractaires français dans la métallurgie). DANIEL PETIT. *Revue de Métallurgie,* Vol. 32, July 1935, pages 282-292. Brief description of the machine used by Petit for testing the physical properties of refractories under different temperature and load conditions including their dilatation properties. An electric furnace, a system of levers and a clock driven recording drum are used in it. The quality of refractories of French manufacture is as high as of any foreign make. This is shown by several tables of figures and charts obtained on different materials by a German laboratory. JDG (6)

Industrial Electric Heating. Part I. (Industrielle Elektrowärme. I). MASUKOWITZ & KNOOPS. Arbeitsgemeinschaft zur Förderung der Elektrowirtschaft, Berlin, 1935. Paper, 6 x 8¾ inches, 64 pages. This is a primer on electric heating, chiefly in the metallurgical industries, prepared by a German organization of electric furnace builders. The story is chiefly told in many very good illustrations showing the types of furnaces available, sometimes with contrasting pictures of old coal fired installations to bring out the cleanliness of electric heat. New technical details are given, and most of the statements are of a very general nature. However, the story of the advantages of electric heat is forcibly presented in small space. In 1934 over 25% of the electric energy used in Germany for industrial purposes, was for heating, chiefly in the metallurgical and ceramic industries. H. W. Gillett (6) -B-

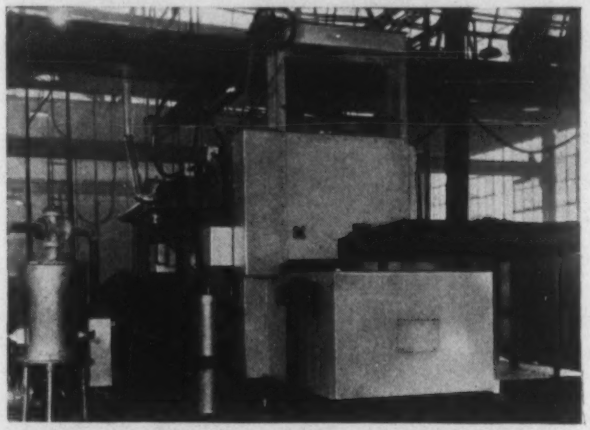
Equipment in Commercial Heat Treating Plant. H. M. HEYN. *Heat Treating & Forging,* Vol. 21, Oct. 1935, pages 473-474. Describes equipment in plant of Lindberg Steel Treating Co., Chicago, with special reference to furnaces, of which there are more than 40. MS (6)

Notes on Refractories for Electric Furnaces Producing Special Irons. L. C. HEWITT. *Transactions American Foundrymen's Association,* Vol. 6, Aug. 1935, pages 577-583. The introduction of a comparatively new type of refractory classified as super fire-clay brick has greatly aided in reducing refractory costs for the indirect arc furnaces and should find application as a roof material for the direct arc roof. This refractory is noted particularly for its combination of low porosity and high thermal shock resistance together with high refractoriness and volume stability at high temperatures. Careful lining installation with minimum joints, use of proper bonding cement, precautions during preliminary heating, close control over superheating temperatures and the use of some special compounds such as those of Ba as a metal cleanser and lining conditioner are among the service factors cited that bear upon the refractory performance. CEJ (6)

Electric Melting Furnaces (Elektroschmelzöfen). M. KAUCHTSCHISCHWILI. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Aug. 31, 1935, pages 1057-1062. Characteristics and modern development of the various types of electric furnaces for melting of metals are discussed. In the front rank today are arc and induction furnaces. The induction crucible furnace finds wide application in steel and metal industry. 12 references. Ha (6)

Investigations on an Electrically Heated Enameling Furnace (Untersuchungen an einem elektrisch beheizten Blech-Emaillierofen). H. MEYSENBURG. *Elektrowärme,* Vol. 5, Oct. 1935, pages 246-252. Operating data for a furnace for enameling parts of electric ranges showed that it was equivalent and in some respects superior to a coke-fired furnace. Ha (6)

Scale-Free Hardening Furnaces



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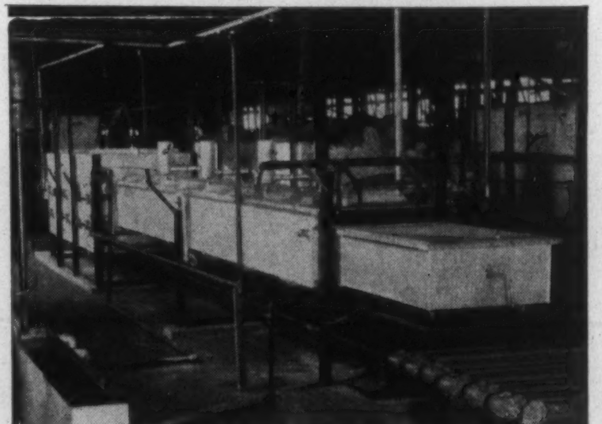

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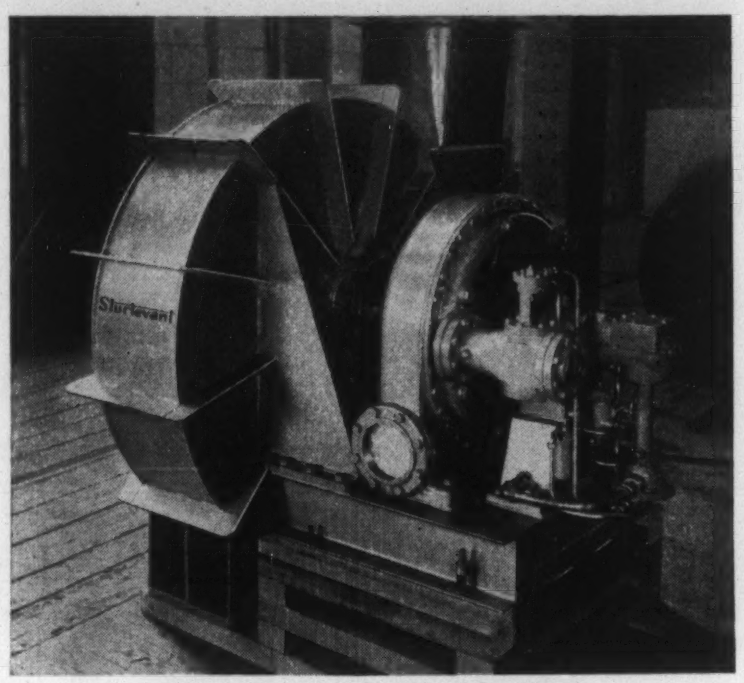

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Electrically Heated Hardening Furnaces for Light Metals (Elektrisch beheizte Vergütungsöfen für Leichtmetalle). H. FARSKY. *Aluminium*, Vol. 17, Sept. 1935, pages 481-483. Furnaces for the correct heat treatment of the precipitation hardening Al-Cu-Mg alloys, in particular salt baths for rivets are described. Design features and temperature control are discussed. Ha (6)

New Uses of Refractories. F. HARTMANN. *Iron & Steel Industry*, Vol. 8, Sept. 1935, pages 469-470. Summary of paper which appeared in *Berichte der deutschen keramischen Gesellschaft*, Vol. 16, (I), 1935. Refractory bricks usually consist of 2 materials: a non-plastic constituent or aggregate, and a bond. When a pure chemical compound can be used as an aggregate with a very small proportion of bond, the refractoriness of the material, as a whole, is likely to be higher and the resistance to slag will be higher than when less pure substances are used. The use of highly purified materials is prohibitive for many purposes on account of their cost. The properties of some of the modern refractories are briefly reviewed. CEJ (6)

The Properties of Clays From Different Sources. J. B. BLEWETT. *Transactions American Foundrymen's Association*, Vol. 6, Apr. 1935, pages 418-424. The author discusses the properties of fire clays from various districts. Necessary properties listed are bonding power, plasticity when mixed with water, retention of shape under heated conditions, resistance to abrasion, fluxing and spalling. In clay mixtures, maximum strength is obtained with the use of irregular angular grains of varying sizes, which can interlock freely. The strength in both dried and fired states increases with the fineness of grain. Little advantage appears in grinding finer than 65 mesh. One table compares the chemical compositions of representative clays from various districts and another gives the firing properties. CMS (6)

Recent Improvements in the Physical Properties of Silica Brick. SANFORD S. COLE. *Blast Furnace & Steel Plant*, Vol. 23, Mar. 1935, page 221; Apr. 1935, page 288; May 1935, pages 352-353; June 1935, pages 429-430; July 1935, pages 498-499; Aug. 1935, pages 573-574. Use of brick molding machine in manufacture of SiO_2 brick has resulted in uniform brick of even size. By use of unwarped shapes, steel makers have obtained 15-50% longer campaigns from openhearth roof tiles. Abrasion varies usually with crushing strength of brick. Quartzite having low-fired porosity will be strong and tough, and brick made from such rock are also strong and more resistant to abrasion. Rate of abrasion is greater at room temperatures than at higher temperatures. Increasing Fe_2O_3 and TiO_2 content of brick improves bond with resulting increase in crushing strength and resistance to abrasion. Adding Fe in colloidal form or in combination with Ti gives better bond than oxide form. Firing schedule affects physical properties of brick. Well bonded brick are obtained when kiln atmosphere is slightly reducing during high-temperature firing. MS (6)

The Development of Convection Heating Equipment. *Industrial Heating*, Vol. 2, Sept. 1935, pages 476-492. Development in design and construction of convection type furnaces and ovens and their auxiliary equipment is reviewed and the advantages of this type of heating are explained. Many examples from steel and ceramic industries are described. Ha (6)

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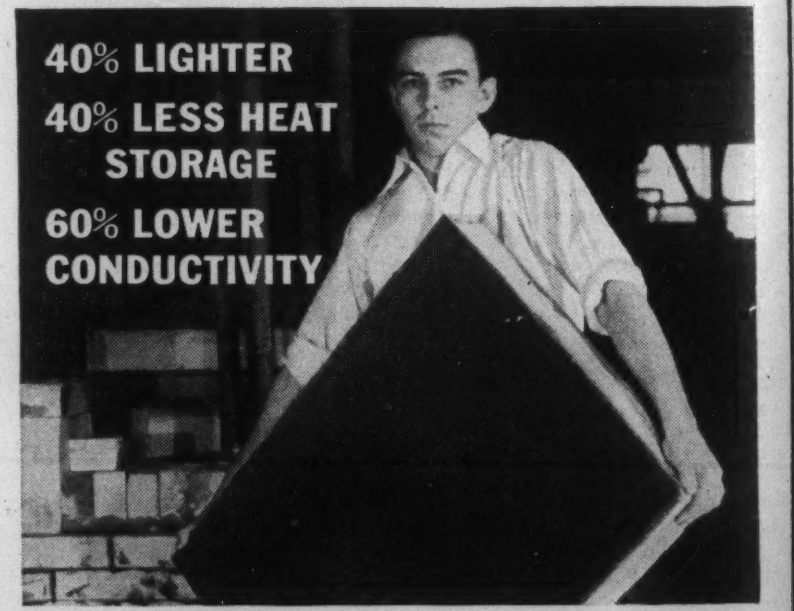

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Heat Treatment by Inductive Heat. H. G. Remmers. *Iron & Steel Industry,* Vol. 8, Aug. 1935, page 453. See "Heat Treatment and Paint-Drying by Inductive Heat," *Metals & Alloys,* Vol. 6, Apr. 1935, pages 85-86. CEJ (6)

Design and Construction of Hot Blast Stoves. Albert Mohr, Jr. & Fred Wille. *Blast Furnace & Steel Plant,* Vol. 23, Oct. 1935, pages 689-694, 702. Same as *Iron Age,* Vol. 136, July 4, 1935, pages 12-17. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 398R/9. MS (6)

Refractory Insulating Brick for Modern Annealing Furnaces (Feuerfeste Isolierbausteine als Baustoffe neuzeitlicher Glühöfen). E Senfter. *Archiv für das Eisenhüttenwesen,* Vol. 8, May 1935, pages 473-478. Heat losses through the walls and recuperators of an annealing furnace account for from 60 to 80% of the fuel consumption. Lightweight refractory brick have sufficient insulating properties to reduce the losses materially; in annealing furnaces operating at 700° to 900° C. they resulted in fuel savings up to 50%. SE (6)

Fundamentals, Development, and Examples of Calculations of Technical Combustion, Part III. Development of Formulae for Calculating the Heat Given off in the Furnace by the Combusted Gases (Grundlagen, Entwicklung, und Beispiele feuerungstechnischer Berechnungen III. Teil: Grundlagen und Aufbau der Formeln zur Berechnung der von den Verbrennungsgasen im Ofen abgegebenen Wärme). H. Schwiedessen. *Archiv für das Eisenhüttenwesen,* Vol. 9, July 1935, pages 23-30. Continuation of discussion in two preceding parts. SE (6)

Packard Heat Treating Process Mechanized. *Heat Treating & Forging,* Vol. 21, Oct. 1935, pages 491-492. Describes automatic unit recently installed in plant of Packard Motor Car Co., Detroit, Mich. MS (6)

Combustion Properties of Industrial Propane. W. Z. Friend. *Heat Treating & Forging,* Vol. 21, June 1935, pages 297-301; July 1935, pages 345-349; Aug. 1935, pages 394-396. Deals with chemical and physical properties; conditions of gas combustion; heat loss at various temperatures; B.t.u. value; flame temperatures; rate of flame propagation; limits of flammability; ignition temperatures; available heat; specific heat; vapor-pressure, dew-point, and other thermo-dynamic properties; luminous and diffusion flames; and furnace atmospheres. Data are presented in charts and tables. Includes information on other gases. MS (6)

Brickmason and the Blast Furnace. Pt. II-V. Henry D. Tyson. *Blast Furnace & Steel Plant,* Vol. 23, July 1935, pages 472-474; Aug. 1935, pages 538-540; Sept. 1935, pages 616-618; Oct. 1935, pages 698-700. Describes procedure for laying brick in the blast-furnace, stoves and open hearth. MS (6)

The Influence of Climatic Conditions Upon Furnace Practice. W. Trinks. *Industrial Heating,* Vol. 2, Sept. 1935, pages 507-508. Attention is directed to the fact that in a hot, humid climate furnace inspection and watching, especially of the roof of open hearth furnaces is less liable to be satisfactory than in a cooler, dry climate on account of the human factor. Automatic control with little time lag is, therefore, advisable in the former case. Ha (6)

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7. JOINING

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

A New General-Purpose Meter for Resistance Welding. C. Stansbury. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 32-35. With the meter it is possible to measure the secondary current which flows for a fraction of a second between the electrodes. The primary current is also measured by the meter as is the welding voltage and the duration of the weld. Author suggests the meter will be used to specify to the resistance welder machine maker the rate of energy input to the actual weld instead of buying equipment on present basis of kva taken from the line. Discussion of meter construction and operation is made, diagram shown and type of curves obtained. WB (7b)

Pipe Welding Requirements. A. N. Kugler. *Industry & Welding,* Vol. 6, Aug. 1935, pages 18-19, 35-38. Describes and illustrates methods used in construction of pipe lines. Example of oxyacetylene welded 12" steam line, 8400 ft. long cited. Ha (7b)

The Welding Symposium. H. C. H. Carpenter. *Metal Treatment,* Vol. 1, Summer 1935, pages 57-58, 62. An account of the circumstances which led to the organisation of the Welding Symposium by the Iron and Steel Institute and a brief review of the 130 papers presented. JCC (7b)

Welding in Reinforced Concrete Work (Das Schweissverfahren im Eisenbetonbau). Fritz v. Emperger. *Beton & Eisen,* Vol. 34, May 20, 1935, page 164. A critical discussion on the utilization of welding for the latest German standard structural steels St 52 and St 55. WH (7b)

Experiences with A.C. Welding. R. D. Eaglesfield. *Welding Engineer,* Vol. 20, Aug. 1935, pages 29-30. Advantages of a.c. welding over d.c. welding are discussed; they consist chiefly in absence of sudden chilling actions due to the frequency of the a.c. circuit, finer grain structure obtained and reduced tendency to entrap slag. A number of cases are reported where a change from d.c. to a.c. eliminated serious troubles. Ha (7b)

Application of Welding in S. S. Normandie Construction at the Penhoët Ship Building (Application de la Soudure sur "Normandie" au Chantier de Penhoët). W. Faerman. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, May-July 1935, pages 1796-1824. Lecture before French Welders' Society. Description is divided as follows: (1) welding hull, (2) arc welding, (3) resistance welding, (4) torch welding, bronze welding, gas cutting. FR (7b)

Welded Stirring Propellers (Geschweisste Rührwerkspropeller). Ernst Greger. *Der Autogen-Schweisser,* Vol. 8, Apr. 1935, pages 43-44. Advantages of welded (propeller) agitators over cast ones are pointed out and method of welding is described. WH (7b)

Resistance Welding Methods in the Sheet Metal Industry—III. L. B. Hunt & C. F. Davidson. *Sheet Metal Industries,* Vol. 9, July 1935, pages 459-460. Some notes on seam welding equipment, the control of electrode wear by the use of steel rollers, and projection welding. AWM (7b)

Welded Pressure Vessels. R. K. Hopkins. *Metals Technology,* Aug. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 640, 12 pages. Some oil-refinery pressure vessels must operate at high temperatures, 950-1000° F., and others at sub-zero temperatures as low as —75° F. Vessels are required to operate at pressures as high as 1000 lb./in.^{2} Many vessels are required to withstand the attack of very corrosive liquids. Satisfactory vessels now can be fabricated by fusion welding from either C or alloy steel, depending on temperature and corrosive conditions. The weld has mechanical properties as good as those of the original plate, including impact resistance. For vessels used at very low temperatures a 2.25% Ni steel is recommended because the impact resistance of a C steel at these temperatures may be low. Test results are given to show that even the Ni steel may have very low impact resistance at —75° F. after certain treatments—normalizing from 1900° F. and tempering at 1150° F. The same steel had a good impact resistance when normalized from 1525° F. and tempered at 1150° F. The usual heat treatment before shipping consists in heating to 1150° F. and holding 1 hr. for each in. of thickness. Vessels of almost any wall thickness can be fabricated by welding. JLG (7b)

Repairs to, and the Construction of Gasholders by Electric Welding. H. H. Hollis. *Gas Industry,* Vol. 12, May 1935, pages 252-257. Reconditioning of gas holders by electric welding is discussed. Advantages of electric welding over riveting are pointed out. A full fillet weld on the outside with tack welds on the inside produces a seam with strength equal to that of the plate. It is bad practice to use tape for the purpose of making gas holder seams gastight. Tape also aggravates the corrosion of seams at the lap edges. WH (7b)

Welding the Stainless Steels. A. P. Johnston. *Welding Engineer,* Vol. 20, Aug. 1935, pages 19-22. Welding procedure for 18-8 steels and preparation and subsequent treatment of work are described; dimensions of electrodes and currents to be used are given. Ha (7b)

Weld Metal and Rolled Steel, How Do They Work Together? Riddervold Jensen. *Welding Engineer,* Vol. 20, Aug. 1935, pages 26-29. Stress-strain diagrams were determined with rolled steel plates welded with different electrodes. Satisfactory joints can be made easily if the weld metal has tensile properties corresponding closely to those of the parent metal to which it is applied. Heavy-covered electrodes are very well suited for the requirements. A method of calculating the stresses developed by cooling is described. Ha (7b)

Electric Welding (La Soudure électrique). G. Moressée. *Revue Universelle des Mines,* Vol. 11, Aug. 1935, pages 345-361. Principles of arc and resistance welding are discussed, the various procedures explained, metallurgical changes in the weld described and illustrated by micrographs. Control of welders, testing methods developed, standards accepted are discussed. Ha (7b)

Brazing with the Electric Arc. Miles C. Smith. *American Machinist,* Vol. 79, Aug. 28, 1935, pages 614-616. A welding process, preferably for cast Fe, is described in which the metallic electrode has a much lower point of fusion than a mild steel electrode often used. Electrodes of Cu, bronze, Cu with steel sheath, Ni-Cu, with or without coat and used with or without flux are discussed. This method has the advantage over welding with oxy-acetylene, that the weld deposit is sufficiently ductile to absorb many of the expansion and contraction stresses. The low fusing point of the electrode avoids excessive thermal stresses. Best procedure is discussed. Ha (7b)

Welding-In of Staybolts in Locomotive Fire Boxes Made of Copper (Einschweissen von Stehbolzen in kupferne Lokomotiv-Feuerbuchsen). Silbereisen. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 90, Jan. 15, 1935, pages 31-32. Due to the continuous heating cycles, tightly fitting and adequately caulked staybolts begin to leak. Preliminary tests indicated that a certain V-weld was best. Autogeneous or electric welding may be utilized. The bolts are placed in countersunk holes so that a smooth fire box wall is obtained after welding. The thread on the bolt is not discarded since the purpose of welding is only to prevent leaking. WH (7b)

Accomplishments of Welding Shops in German Shipyards V, VI (Aus deutschen Schiffbau-Schweisswerkstätten V, VI). R. Schmidt. *Werft, Reederei & Hafen,* Vol. 16, May 1, 1935, pages 140-141; July 1, 1935, page 217. Continuing a previous series, illustrations of typical welding jobs carried out in German shipyards are shown. There is no special text; a few lines accompany each picture, which clearly brings out the salient features. WH (7b)

Control of Electric Resistance Welding. P. W. Townsend. *Sheet Metal Industries,* Vol. 9, July 1935, pages 461-463, 468. From a paper at the Symposium on the Welding of Iron and Steel, organized by the Iron and Steel Institute. Describes very briefly the many control systems available for use. Both automatic and non-automatic controls are treated. AWM (7b)

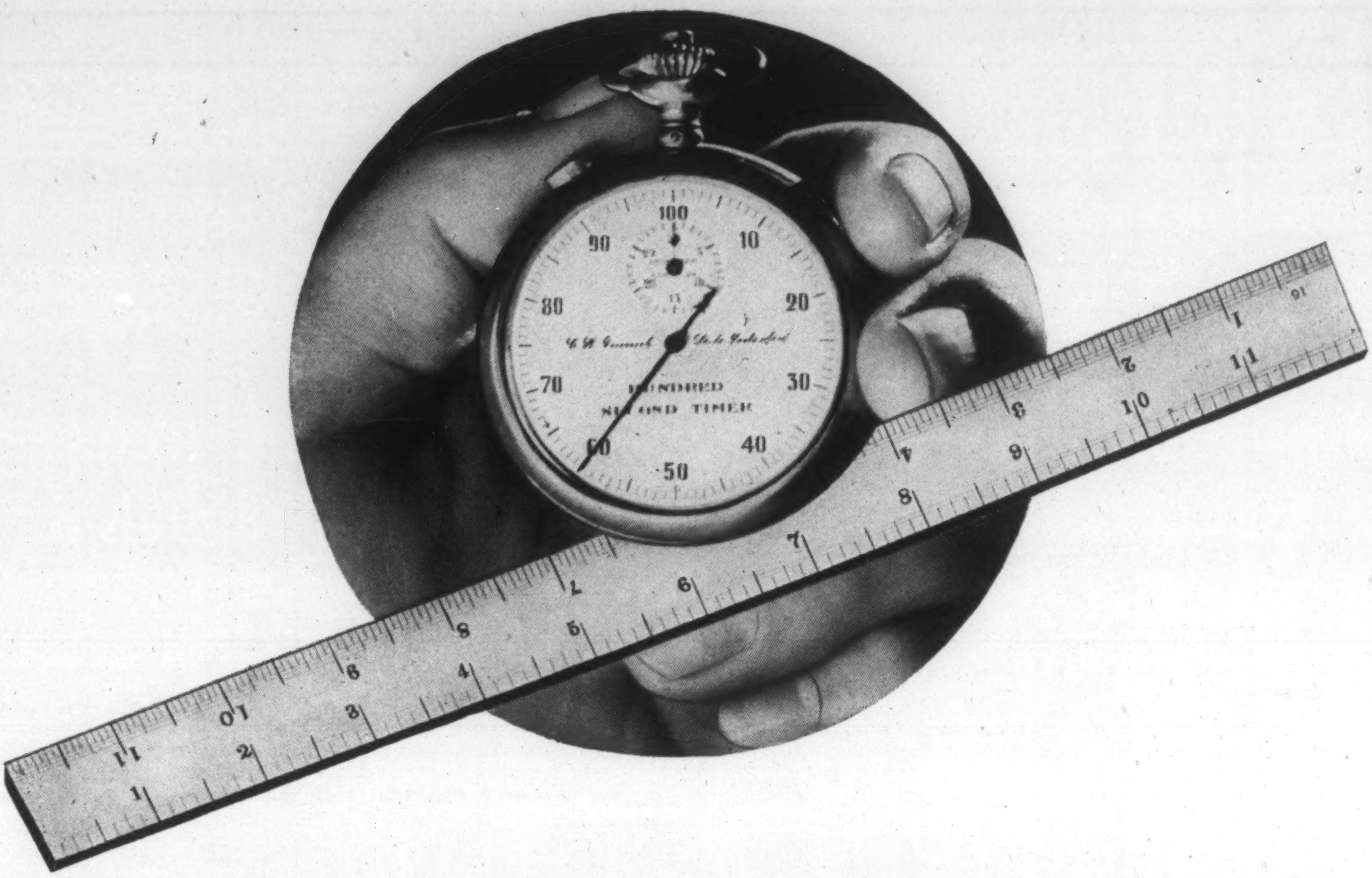
Improving Railway Equipment and Operation. H. Clapp. *Commonwealth Engineer,* Vol. 22, June 1, 1935, pages 385-387. States that rail welding is being extensively used in Germany and Italy. In the former country, it has been employed since 1928 and about 400,000 joints have been welded with the thermit process and 100,000 by electric welding, both systems being equally satisfactory. In general, the maximum length of welded rails is 200 ft. but in tunnels rails have been welded in lengths up to 10,000 ft. Experimental lengths up to 3000 ft. on open track are under investigation. Rail welding resulted in savings in maintenance of permanent way and rolling stock, longer rail life, labor saving in rail laying, elimination of joint bonding, improved electrical conductivity of track circuits and more comfortable travel. A German company experiments with a machine for electrically welding rails *in situ* by the flash resistance method. WH (7b)

Aircraft Constructional Welding. R. F. Taylor. *Welding Journal,* British, Vol. 32, July 1935, pages 206-208. Materials welded in aircraft construction are: (1) low C mild steels (2) medium C, Mn steels (3) Cr-Mo steel of low C content. Low C (1) are good welding steels but have low yield stress value after welding. C, Mn (2) steels are easily welded and have good strength values after welding. But neither are as good as low C, Cr-Mo steels which are not only easier to weld but the yield and fatigue properties are satisfactory after welding, provided the C is not allowed to exceed .25%. With C, Mn steels there is danger of brittleness after welding thin tubes due to the high rate of cooling; this is especially true if C and Mn are on the high side of .3% and 1.75% respectively. Details of welding procedure are given. Heat treatment after welding is recommended. Welding in non-rigid jigs is recommended so as to allow for expansion and contraction. Resistance, spot and seam welding are discussed. Load per spot figures for single and double shear are given for various gages of sheet from 22 to 10 for mild steel sheet and medium C steel of .3% C and 1.75% Mn. Conclusion is that portable spot and seam welders with remote electrodes have best application in aircraft welding. WB (7b)

Controlling Heat Effects. Owen C. Jones. *Welding Journal,* N. Y., Vol. 14, July 1935, pages 6-7. Preheating for bronze welding of castings is recommended in order to have balanced stress conditions when part is put back into service after weld repair. The necessity for preheating will depend upon type of casting, nature and location of the fractures and experience of the repair supervisor. Examples of repairs are given. WB (7b)

A Study of Porosity in Metallic Arc Welding Under Specific Conditions. J. S. Johnson. *Welding Journal,* N. Y., Vol. 14, July 1935, pages 10-14. Study of one pass, full bead welding conditions using a Cu backing plate to quench the deposit. These conditions always have porosity of the weld metal associated with them which research has shown to be caused by oxide scale on the opposite side of the plate welded or on the surface of the Cu backing plate. The holes are clean and bright thus showing that the gas contained in them was not reactive enough to oxidize the surface of the cavity. The presence of CO due to reaction of the oxide scale with the C of the melted metal is suspected from the observations made. X-ray photos show that the effect of cleaning the plate free from oxide is to obtain a nonporous weld. WB (7b)

Urges Stress Relief for All Welded Pressure Vessels. D. S. Jacobus. *Steel,* Vol. 96, May 13, 1935, pages 29-30. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 362R/4. MS (7b)



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Electric Arc Welding and Its Applications. II. M. MAURICE LEBRUN. (Translated from French) *Welding Journal*, British, Vol. 32, July 1935, pages 198-201. Discussion of influence of electrode coating on weld quality and ampere discharge or heat content of the arc, which is less with the coating due to its blanketing effect. The current may be reduced 25% from that required with bare electrodes. The influence of the coating on the potential difference across the arc is such that the potential increases due to the coating being a poor conductor of electricity. The potential also gradually increases with the diameter of the rod. The influence of the coating on weld quality is shown by comparison where bare rod weld stood up for about 20% of the duration of parent metal in bending machine while with coated rod 80-90% of the number of bends withstood by the parent metal could be taken. If the coated rod weld is forged its resistance to breaking in bending is the same as for the parent metal. Differences are shown between refractory and fusible rod coating; the former gives only slight protection to the weld but is easily removed by cracking and scratch-brushing. The latter coating gives a thick slag which completely protects the weld by spreading over melted metal but the cleaning operation to remove the slag takes longer and is more difficult to perform properly. Coatings for rods must be studied metallurgically because the wrong coating can do more harm than good. Magnetographic method of examining welds is briefly reviewed. Further installments of this book are to appear in the journal. WB (7b)

Testing of Welds (Prüfung von Schweissverbindungen) Report of Vereins deutscher Eisenhüttenleute. *Stahl und Eisen*, Vol. 55, Sept. 5, 1935, pages 953-961. This is a correlated abstract in which many of the foremost testing engineers in Germany collaborated. Welds must be tested in the same condition, form, and under the same stresses as they are used, so that their load bearing ability, deformability, fatigue, and impact resistance must be determined by means of tensile, bend, fatigue, and impact tests. Various types of the latter are discussed. Tests mentioned are mainly twisting and hammering of V-welds. Weldability in gas and electric-arc welding appears to improve with Mn content, attaining a maximum with 1.6% Mn. For a test of fusion welding of seamless tubes a welded ring was expanded to failure. Non-destructive tests of welds—radiographic and magnetic—as well as tests of stress distribution in welds, are very helpful. 28 references. SE (7b)

Oil Well Casings Now Lindewelded. *Oxy-Acetylene Tips*, Vol. 14, Sept. 1935, pages 197-202. Lindewelding is an oxy-acetylene welding process using a high test steel welding rod; the base metal is rapidly melted and a greater welding speed results than in the ordinary welding methods; a welding rod of larger diam. can be used. Backhand welding method is employed. Examples of pipe lines and casings, and procedure in the field are described. Ha (7b)

More Uses for the Air-Acetylene Flame. *Oxy-Acetylene Tips*, Vol. 14, Sept. 1935, pages 202-204. The air-acetylene flame provides a small, intense flame which can be more easily controlled than the oxy-acetylene flame and has a somewhat lower temperature than the latter. It is used for small work. Examples are shown, using in particular the enclosed flame process, i.e., the flame is enclosed in a soldering iron. Ha (7b)

New Welded Steel Bulkhead System for Oil Tankers and Other Fluid Storage Vessels. G. D. SPACKMAN. *Welding Journal*, N. Y., Vol. 14, July 1935, pages 2-6. New welded design bulkhead compared with riveted construction and design. Testing of bulkhead of experimental size is shown in photos and diagrams. Results are plotted. WB (7b)

Largest All-Welded Bridge Completed in New Jersey. A. F. DAVIS. *Welding Journal*, N. Y., Vol. 14, Aug. 1935, pages 1-4. Photos and text refer to Rancocas river bridge which is entirely arc welded. WB (7b)

Review of Piping Standardization Shows Vast Amount of Work Done. SABIN CROCKER. *Industrial Standardization*, Vol. 5, Mar. 1934, pages 48-50. See "Welding High-Pressure High-Temperature Steam Piping," *Metals & Alloys*, Vol. 6, May 1935, page MA 195L/1. AHE (7b)

The Development of Weld Testing as Indicated by Published Literature. M. F. SAYRE. *Welding Journal*, N. Y., Vol. 14, Aug. 1935, pages 4-6. Survey of the frequency of welding references in technical literature, journals devoted to welding and a review of the chronological increase in interest in welding in the major countries of the world. Other sources for welding information are given and other than welding journals which have published references to weld testing. WB (7b)

High Voltage Condenser Welding. G. I. BABAT. *Welding Journal*, N. Y., Vol. 14, Aug. 1935, pages 6-8. Spot welding by means of an inductive circuit charging a condenser and discharge through a Hg cathode tube is discussed. Control of energy and time for each spot is possible with the new welder. The wave form of the discharge and photos of the welder are shown. The proposed use for the machine is for aircraft repair and construction on thin sheets of metal. Sheets of 18 and 8, .10 to .60 mm. thick have been welded by this process as also have dural, super-dural. A small power network can supply the welding energy but the time between the condenser discharge or welding of spot increases with decreases in the size of the power supply. WB (7b)

Electric Welding and Alloys in Mine Cars. CHESTER G. SENSENICH. *Mining Congress Journal*, Vol. 21, July 1935, page 47. Electric welding and the use of rust resistant alloys have given added strength, increased capacity, and longer life to mine cars, without increase in tare weight. Coated wire is best for welding of mine cars. In continuous lap welding of mine cars every joint should be sealed. Addition of Cu to increase corrosion resistance has become a well established practice. Addition of Mo has also proved a great benefit in mine car construction, as it imparts extra strength to withstand shocks and impact stresses. BHS (7b)

A New Design of Spot Welding Electrodes. G. KOMOVSKI. *Welding Journal*, N. Y., July 1935, pages 14-15. Description and characteristics of the tapered electrode are given, and current density distribution shown in curves. WB (7b)

Some Aspects of Welding in Aircraft Construction. J. Roosenschoon. *Welding Journal,* British, Vol. 32, July 1935, pages 209-212. In practice all welds are more or less restrained in expanding as well as in contracting; thus, stresses may occur in welded joints from zero to nearly the yield point. The points discussed are: (1) avoidance of cracks and stresses (2) interchangeability of parts, (3) special alloy steels. Aircraft are subjected to static, impact and vibrational loads. The static and vibrational loads are superimposed on the already existing welding stresses. If the latter are large enough to get near the fatigue limit the vibration will open up fatigue cracks. Early experience of Fokker Works showed that mild steel of high purity and low Si had little tendency to crack and that during welding the part had to be unrestrained to avoid stresses building up. Discussion is given of weld design of various parts. Interchangeability problems connected with welding of aircraft and customer requirements. Special alloy steels such as stainless steels in thin sheets, .7-1.2 mm., are welded for exhaust manifolds and Cr-Mo tubing and sheet for trusses and fillings. The stainless steels are not easily welded and require considerably more skill than mild steel. Fokker has not been using Cr-Mo steel for all joints because of air hardening and liability for crack formation in neighborhood of weld since heat treatment is not always possible. The coarse grain in the weld is not remedied by using alloy rod. Conclusions of Fokker are that relatively simple constructions with carefully studied joints, which minimize the danger of high welding stresses, may be built in Cr-Mo steel and they are as reliable as mild steel structures. For larger and highly complicated trusses more experience is required. WB (7b)

Electric Welding in Japan. Minoru Okada. *Welding Journal,* N. Y., Vol. 14, June 1935, pages 10-15. In Japan a-c. welding is practiced to a great extent with coated rods. Statistics of welding rod consumption in various industries are tabulated for 1929 to 1933. Compositions of rod coatings are tabulated. Photos of various structures are shown. A chart of % of alloy elements retained in deposited metal and a brief review of results of research on ferrous and nonferrous metals is given. WB (7b)

Repairing of Cast Iron Pieces by Weld-Brazing (Réparation des Pièces de Fonte par Soudo-Brasure). J. Gouttier. *Revue de Fonderie Moderne,* Vol. 29, Sept. 10/25, 1935, pages 280-281. "Weld-brazing" is the name given to a process of joining metallic pieces which are prepared in the same manner as for autogenous welding. An alloy is used which fuses easily and amalgamates with the surfaces of the pieces to be joined without bringing the latter to the melting state; the oxy-acetylene flame is employed. The alloy used in the joint is a silicon brass similar to Tobin bronze; density 8.3, m.p. 880° C., tensile strength 43 kg./mm.^{2}, Brinell hardness 115, measured on the deposited metal. A flux with a borax base is used. When weld-brazing cast iron the alloy, in form of rods of 2-6 mm. diam., is heated to between 650°-850° C., as the alloy "wets" the cast iron only in this temperature range and makes a satisfactory joint. Expansion and shrinking are less accentuated in this method than with the autogenous method as the temperatures are lower. Exact procedure is described. Ha (7b)

Planning Arc Welded Bridge Construction. Lamotte Grover. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 21-25. Details of design and procedure with discussion and photographs. WB (7b)

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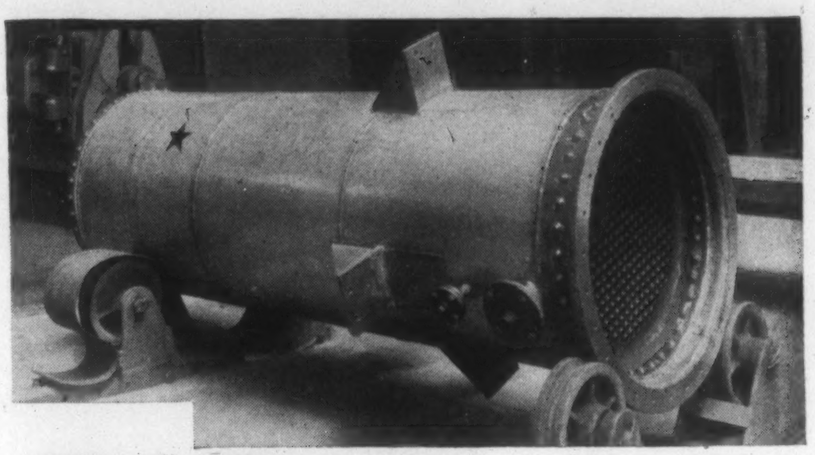

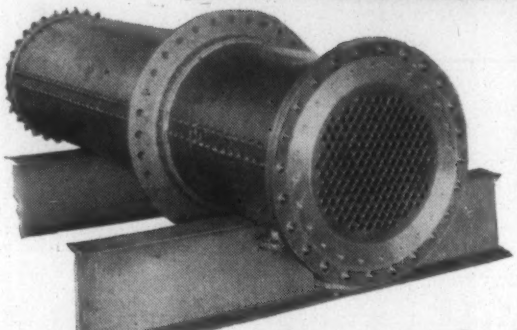

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8. FINISHING

H. S. RAWDON, SECTION EDITOR

Finishing Zinc and Aluminum Die-Castings. H. Chase. *Machinery,* N. Y., Vol. 42, Oct. 1935, pages 120-122; Nov. 1935, pages 181-184. Die castings are often finished by lacquering, enameling, japanning, varnishing or plating. Various methods for preparing the castings for these finishes are described. Ni is recommended as the base coat on Al and usually also on Zn castings. Zn parts exposed to weather should receive first a Cu coat of 0.0005″ followed by 0.0003″ to 0.0005″ of Ni and 0.000025″ of Cr. A solution for Ni plating on Zn is: Ni sulphate 10 oz./gal. water, anhydrous Na sulphate 10-15 oz./gal., NH_4Cl 2-3 oz./gal., boric acid 2 oz./gal., pH 5.8-6.2. Al parts are generally polished but not plated. Ha (8)

The Protection of Metals by Coatings. W. H. J. Vernon. *Metal Industry,* London, Vol. 46, Mar. 1, 1935, pages 239-241; Mar. 8, 1935, pages 276-278; Mar. 15, 1935, pages 307-308. Paper presented at a joint meeting of the London Local Section of the Institute of Metals and the Electrodepositors' Technical Society, in London, on Feb. 14, 1935. The importance of protective coatings on metals is evident when it is realized that for practically all metals the metallic condition is a metastable one. The adhesion of natural protective coatings depends upon a chemical bond between the coating and base metal. Coatings are discussed under 2 main classes: (A) coatings having a chemical bond with the basis metal, and (B) coatings that do not. Under (A) are considered (1) natural oxide coatings (natural varnishes), (2) natural coatings of corrosion products (natural paints), (3) artificial oxide coatings, and (4) artificial coatings of corrosion product. Under (B) are included (1) paints, varnishes, lacquers, enamels, rubber coatings, etc. and (2) metal coatings. Since only coatings that are of interest to the metallurgist or the electrodepositor are discussed, (B-1) is simply mentioned. Under (B-2) are grouped coatings produced by (a) "Rolling-on" (b) "Hot-dip" process, (c) cementation and (d) metal spray ("metallization"). Thus far, the author has considered the protection against corrosion obtained by substituting a surface with a relatively high corrosion resistance for one of less resistance. On the basis of the electrochemical relationship between coating and base metal coatings are classified as cathodic or anodic. Cathodic coatings are "noble," i.e. they have a higher intrinsic resistance, but in the presence of an electrolyte, tend to accelerate corrosion of the basis metal. Anodic coatings have a lower resistance to attack but are capable of exerting "sacrificial protection" to the basis metal. The author believes that too much attention is paid to the "sacrificial" type of coating rather than to the development of coatings of maximum soundness and of reasonable thickness. In the discussion of electrodeposited coatings the adhesion of the deposit, its thickness and porosity are considered. HBG (8)

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8a. Pickling

Pickling Problems. Discussion before the Midland Metallurgical Societies. *Metal Industry,* London, Vol. 46, Feb. 22, 1935, pages 215-217; Mar. 1, 1935, pages 247-249. Most of the problems described relate to pickling Fe and steel but some consideration is given to the pickling of non-ferrous metals. From the practical standpoint one speaker pointed out that (1) within limits it is more important to control temperature than acid concentration and (2) by adjusment of conditions it is possible to obtain identical results with either H_2SO_4 or HCl so that cost is one of the deciding factors. In considering non-ferrous pickling the construction of vats, washing after pickling, inhibitors, continuous pickling, temperature control, sand blasting and mechanical pickling were discussed. HBG (8a)

The Acid Pickling of Non-Ferrous Metal Components. P. Mabb. *Machinery,* London, Vol. 46, Aug. 29, pages 661-663. Pickling is usually performed in two steps, first, slow pickling to remove surface material and rapid second step to give final surface. Importance of degreasing is stressed and trichlorethylene or alkali bath is recommended. Procedure is given for Cu and brasses (up to 42% Zn), bronzes, Ni and white Ni alloys, Al and alloys, Mg and alloys, Zn base alloys in the various pickling processes. WB (8a)

Pickling Iron and Steel with Acids and Use of Inhibitors (Descapado al Acido de Hierros y Aceros y Empleo de Moderadores). I. Grifoll. *Metalurgia y Construcción Mecánica,* Vol. 1, Oct. 1935, pages 6-8. The mechanism of pickling, the chemical reactions of the different oxides FeO, Fe_2O_3 and Fe_3O_4 and the role of inhibitors are explained. 7 references. Ha (8a)

Method for Bright-pickling Metals (Verfahren zum Blankbeizen von Metallen). W. Heimberger. *Oberflächentechnik,* Vol. 12, Oct. 1, 1935, page 238. Instead of the usually employed H_2SO_4 and HCl of higher than 10% concentration, DRP 618,614 uses salts of the Mg, alkaline earth and alkali groups including Al, together with mineral acids. The following compositions give good results for Fe: 1% HCl + 2% $MgSO_4$, 1% HCl + 2% $NaNO_3$, 1% H_2SO_4 + 2% KNO_3, 4% $K_2S_2O_8$ + 2% $NaNO_3$. Mixtures of these liquids may also be used. The best pickling temperature is 80° C. For very rusty or scaly material, a preliminary pickling in 2% H_2SO_4 + 2% KNO_3 at 70° C. is recommended with subsequent pickling in ¼% H_2SO_4 + 2% KNO_3 at 80° C. for 1 min. which will produce a very satisfactory surface. Neutralizing after pickling is not necessary, rinsing in H_2O is sufficient. Non-ferrous metals and their alloys, e.g. Cu and brass, can be pickled with these solutions in preparation for painting, galvanizing or enamelling. Ha (8a)

8b. Cleaning including Sand Blasting

The Detergent Properties of Alkalies, Particularly Plating Cleaners. N. Promisel. *Monthly Review, American Electroplaters' Society,* June 1935, pages 4-19. Some of the chemicals used in cleaners are Na_2CO_3, NaOH, tri Na phosphate, Na metasilicate pentahydrate, NaCN, NaCl, Na_2SO_4, Na borate, soap, and sulphonated higher alcohols. The effect of any given constituent in a cleaner was studied by using first a cleaner of a composition found to be good by industrial experience, and then systematically varying the amount of a particular constituent. Cleaners were evaluated on: (1) wetting ability, that is, the area over which a drop of cleaner spread when placed on a piece of glass was measured; (2) displacement of oil from surface of oil wetted test tubes; (3) emulsification of mineral oil, determined by the "Stalagmometer"; (4) chemical activity; a composition binder (50% stearic acid, 50% tallow) being treated with some cleaner and the amount of saponification measured by titration; (5) deflocculation by observing the result when a quantity of "dirt" was shaken up in 100 cc. of cleaner in a cylinder the amount of dirt remaining in the supernatant liquid at the end of a given period being taken as a measure of deflocculation; (6) alkalinity, pH, and buffer action; (7) tarnish and corrosive effect on metals such as Ni, brass, britannia, Pb-Sn alloys. Conclusions: emulsification is of major importance and soap ranks best in this respect with the sulphonated alcohols (3 g./l.) offering promise. NaOH and Na tetraborate are superior in saponification and Na silicate in deflocculation. The above 4 materials are said to constitute all necessary ingredients in a good cleaner. GBH (8b)

Cleaning and Polishing of Stainless Steel (Décapage-polissage de l'acier inoxydable). C. Auribault. *Métaux,* Vol. 9, Oct. 1934, pages 455-456. Stainless steels are cleaned in 5% H_2SO_4 solution, with a little inhibitor, at 60°-70° C., then in a 5% HNO_3 solution. If cleaning without polishing is desired, the steel is cleaned in a solution of 50% HCl, 44% H_2O, 5% HNO_3, 0.1% inhibitor (glue). Stainless steels are polished with emery No. 120 or emery 80, then with emery 160 and finally with polishes that will give a mirror-like finish. GTM (8b)

Metal Cleaning Here and Abroad. R. W. Mitchell. *Iron Age,* Vol. 136, Sept. 26, 1935, pages 112-113, 116, 122, 126, 132, 134, 141-143. Study of cleaning methods reveals that procedures in this country and abroad are fundamentally very similar as to types of material used, methods and equipment. Mechanical handling has been developed to a higher state in this country than in Europe. Rosin type and colloidal-silicate cleaning compounds, which originated in this country, are finding favor abroad. New synthetic soaps, sulphated fatty alcohols, etc., have been used for some time abroad. Foreign degreasing methods are discussed and a number of illustrations of foreign metal-cleaning equipment given. VSP (8b)

8c. Polishing & Grinding

Flatter vs. Grinder in Gas Rail Welding. G. M. O'Rourke. *Railway Engineering & Maintenance,* Vol. 31, Apr. 1935, pages 221-223. Paper before the 35th annual meeting of the International Acetylene Association, Pittsburgh, summarizes the relative costs of the grinder and flatter methods of finishing rail welds. After 10 years, use of the flatter for finishing rail ends built-up by the oxy-acetylene process, it was concluded that 20% savings could be secured by the use of the grinder. The Brinell hardness of an 0.67-0.8% C rail is stated to be increased from 250 to 265 units by cold rolling under traffic for a period of some weeks, while the hardness of the built-up rail end gained 25 Brinell.
WH (8c)

Cylinder Finishing Methods and Their Effect on the Breaking-in and Service of Motors (Die Verfahren der Zylinderbearbeitung und ihre Auswirkung beim Einlaufen und im Betriebe des Motors). Harry Shaw. *Deutsche Motor Zeitung,* Vol. 12, June 20, 1935, pages 112-113. By means of curves recorded by a surface roughness tester data are presented on the relative wear of a bearing (cylinder) surface when lubricated with ordinary oil and when lubricated with oil containing additions of colloidal graphite. With the latter method, the peaks are ground off, and a partial displacement of the elevated regions takes place. The author suggests the addition of colloidal graphite during honing. Neither finish boring ("Feinbohren") nor honing represents the ideal surface finishing method; a combined use of both is recommended.
WH (8c)

New Grinding and Polishing Agents (Neue Schleif- und Poliermittel). F. Weiss. *Oberflächentechnik,* Vol. 12, Sept. 3, 1935, pages 209-210. During the last few years, several hard substances possessing great chemical stability and very high m.p. have been developed and used for grinding and polishing. A process for manufacturing boron carbide on a commercial scale similar to that used for carborundum has been developed [The Norton Co.]. Tungsten carbide is made by melting tungstic acid, Fe and coal in the electric furnace. For grinding very hard tools, titanium carbide and zirconium carbide are used. Alumina pastes are now used for polishing, especially Al and Al alloys, but also for Cr plated articles and stainless steels. Alumina pastes are preferable to the often used chromium oxide pastes because the dust is much less harmful to the operator as it is not toxic like the Cr oxide dust. Zirconium dioxide is employed for polishing Cr, stainless steels, hard Ni deposits; it can, however, not yet be prepared commercially with absolutely uniform grain size. 11 references.
Ha (8c)

8d. Electroplating

Development of Plating Technique in 1934 as Reflected in the German Patent Literature (Die Entwicklung der Metallüberzugstechnik an Hand der deutschen Patentliteratur). K. Nischk. *Oberflächentechnik,* Vol. 12, Oct. 1, 1935, pages 233-236. A number of the 66 patents granted in 1934 which deal with cleaning and other treatment of surfaces, attempt to increase current yield in Cr plating baths, improvements in Ni plating, deposition of rare metals and plating of Al, are reviewed.
Ha (8d)

Production of Cu-Ni Alloys by Electrolysis of Sulphate Solutions. D. Stepanov, F. Marshak & A. Gorban. *Vestnik Metallopromishlennosti,* Vol. 15, Jan. 1935, pages 126-128. In Russian. In the presence of colloidal matter a sufficiently good deposition can be produced with an acidity 3 to 6 pH and Cu content of 1 kg./l (sic). Homogeneous deposits are formed containing not more than 6-8% Cu.
(8d)

Electrolytic Deposits of Cu-Sn Alloys (Sur le Dépôt Électrolytique d'Alliages de Cuivre et d'Étain). Charles Béchard. *Comptes Rendus,* Vol. 200, May 20, 1935, pages 1737-1739. With electrodes of Cu and Zn short circuited and placed so that the relative exposure of surface can be regulated, brass can be deposited electrolytically from a bath having a constant metallic ion concentration, the deposit having a constant composition. With Cu-Sn alloys, Sn will displace Cu from solution in an electrolyte of complex oxalates of Sn and NH_4 and of oxalates of Cu and NH_4. To ameliorate this tendency, the author recommends a high current density (5-10 amps./dm.^{2}) and a slight amalgamation of the Sn anode with Hg. Discussion is also given of the use of 3 independent electrical circuits. The principal circuit includes the cathode and an insoluble carbon anode. The 2 auxiliary circuits each carry one of the two electrodes Cu and Sn. Such an arrangement affords separate regulation of the current densities.
FHC (8d)

Protective Value of Nickel and Chromium Plating on Steel. William Blum, Paul W. C. Strausser & Abner Brenner. *Mechanical World & Engineering Record,* Vol. 97, Feb. 15, 1935, pages 151-152. Abstract of Research Paper 712, National Bureau of Standards. See *Metals & Alloys,* Vol. 6, June 1935, page MA 236R/3.
Kz (8d)

Electrolysis of Chlorides of Ni and Co in Mixtures of Water and Ethyl Alcohol (Sur l'Électrolyse des Chlorures de Nickel et de Cobalt en Solution dans les Mélanges d'Eau et d'Alcool Éthylique). Claude Charmetant. *Comptes Rendus,* Vol. 201, July 1, 1935, pages 43-45. Author gives in tabulated form, characteristics of Ni or Co deposited in relation to current densities, duration of the electrolysis and concentration of H_2O-alcohol mixture.
FHC (8d)

Electroplating with Iron-Nickel Alloys. D. Stepanov, F. Marshchak & E. Belyakova. *Khimicheskiy Zhurnal,* Ser. A: *Zhurnal obshchey khimii,* Vol. 5 (67), No. 1, 1935, pages 30-33. In Russian. Electrolytic deposits produced by simulaneous deposition of Fe and Ni from solutions of their simple salts in presence of colloids and conducting salts are uniform, have a fine grain, adhere strongly to the base metal, and are elastic in thin layers. If the Ni content of the electrolyte is low the Ni content of the deposit increases, if the former is high the latter decreases with increasing duration of the electrolytic process.
ORS (8d)

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Quantitative Determination of Boric Acid and Citric Acid in Nickelplating Baths (Die quantitative Bestimmung der Borsäure und der Zitronensäure in Nickelbädern). E. Vincke. *Oberflächentechnik*, Vol. 13, July 2, 1935, pages 161-163. Knowledge of the amount of boric and citric acid in Ni plating solutions is necessary for a good product. H_3BO_3 is determined by the method of Joergenson. In presence of much glycerin or uranite, it behaves like a monobasic acid and can be determined with NaOH with phenolphthalein as indicator. The best determination of citric acid was that by the method of Kogan, by which citric acid after being oxidized to acetone in acetic solution by potassium permanganate is converted into iodoform. The procedure in both cases is described and practical examples given to employ in routine measurements in the plating shop. Ha (8d)

Nickel and Chromium Plating of Zinc Parts (Das Vernickeln und Verchromen von Zinkteilen). *Die Metallbörse*, Vol. 25, Feb. 23, 1935, pages 242-243; Mar. 2, 1935, pages 274-275; Mar. 9, 1935, page 307. The difficulties encountered in electroplating Zn are stressed and most suitable baths for Cr and Ni are given. Attention is focussed on tendencies to improve the throwing power of Cr-plating baths. The original paper must be consulted for detailed information. EF (8d)

Nature and Determination of pH Values of Electrolytes (Wesen und Bestimmung der pH Werte in elektrolytischen Lösungen). *Die Metallbörse*, Vol. 25, Feb. 27, 1935, pages 257-258; Mar. 6, 1935, pages 290-291. The significance of "pH-value" is discussed on chemical grounds and its rôle in electroplating processes briefly considered. EF (8d)

Causes for Peeling-Off of Nickel and Chromium Deposits, Its Prevention and Economic Methods for Chromium and Nickel Plating (Die Ursachen des Abblätterns von Nickel- und Chromiederschlägen und ihre Verhütung, sowie die bei der Vernickelung, Verchromung usw. anzuwendenden rationellen Arbeitsgeräte und Methoden). *Metallwaren-Industrie & Galvano-Technik*, Vol. 33, May 15, 1935, pages 121-123; Apr. 1, 1935, pages 142-146. Physical properties and defects of materials, improper treatment prior to electroplating and inadequate electroplating methods are discussed as possible causes of failures. The most economic plating methods as well as modern equipment are considered at great length. EF (8d)

Mechanism of Chromium Deposition from the Chromic Acid Bath. Charles Kasper. *Bureau of Standards Journal of Research*, Vol. 14, June 1935, pages 693-709. In commercial Cr plating the baths used contain principally chromic acid in which the Cr is sexivalent. After use, such baths always contain some Cr^{III}, and many of the theories which were proposed for this process postulate that Cr is deposited from the trivalent, or possibly bivalent, state. Evidence is presented that the electrodeposition of Cr occurs directly from Cr^{VI}. The principal evidence is the fact that relatively large additions of compounds of metals such as Zn, Ni, Cd, Fe, and Cu have no such effect upon the behavior of the chromic acid bath as would be expected if deposition occurred from Cr^{III}. It is shown by cryosopic and spectrophotometric data that the dichromates of these metals are strongly ionized. Low efficiency and high polarization in Cr deposition are accounted for, and certain paradoxes are explained. The possible directions for improvement are pointed out, but none of them appears practicable. WAT (8d)

8e. Metallic Coatings other than Electroplating

Coating Strip with Copper Lead for Ford Rod Bearings. *Iron Age*, Vol. 136, Aug. 8, 1935, pages 25, 47. Low C strip steel, 0.068" thick and 2 1/16" wide is rolled to a channel 1.886" wide to make flanges for bearings. Strip is passed through a Cu-Pb bath maintained at 2100° F. in a 32% Cr alloy pot and held for 1 min. The steel strip is deoxidized by H just before it enters the Cu-Pb bath. As strip moves through bath into graphite die it becomes coated with Cu from Cu-Pb mixture. Graphite die is at 2100° F. with exit end cooled by H_2O jacket. This causes Cu-Pb to freeze solid, and thus holds back hot metal from top. Coated steel passes through friction pulling rolls and is cut to proper length. VSP (8e)

Sprayed Metal and Its Uses. E. J. Tangermann. *American Machinist*, Vol. 79, May 8, 1935, pages 360-363. Development in the last 3 years of methods of metal spraying, building up worn parts and alumetizing is reviewed. Preparation of work for effective bonding of the applied coating and equipment are described. Ha (8e)

Metallic Protective Coatings. I. G. Slater. *Sheet Metal Industries*, Vol. 9, Mar. 1935, pages 139-140. Discussion of Zn coatings applied by hot dipping, sherardizing, metal spraying, and electro-plating. Includes a short discussion of Pb-Sn coatings. AWM (8e)

Metallizing Improves Efficiency. *Metallizer*, Vol. 3, Apr. 10, 1935, page 7. An important application of metal spraying has been developed for coating all welded steam boilers with Al to decrease heat radiation. The coating of 0.01" Al has been found more efficient than the usual asbestos paper in decreasing radiant heat losses and at the same time it prevents corrosion and gives an improved appearance. BWG (8e)

Coloring of Metals to Gold, Silver, Copper and Iron Appearance (Metall-Umfärbung in Gold-, Silber-, Kupfer- und Eisenfärbung). *Metallwaren Industrie & Galvano Technik*, Vol. 32, Dec. 15, 934, pages 539-540. Chemical recipes for producing films of Au, Ag, Cu and Fe on the most commonly used metals and method of securing a Au deposit to accompany a Ag coat. EF (8e)

Why the Fan Spray Nozzle? Chas. Boyden. *Metallizer*, Vol. 3, May 10, 1935, pages 6, 7. Instructions are given for obtaining uniform metal coatings by spraying. Hose should be wrapped around the forearm of the operator. Use of a fan spray nozzle whereby two jets of air, diametrically opposite, impinge on the stream of atomized metal to flatten the stream has proved very satisfactory. It gives a wider and thinner coating than the conventional nozzle, hence more coatings are needed to build to a definite thickness. BWG (8e)

8f. Non-Metallic Coatings

Electron Diffraction Examination of Protective Films Deposited on Magnesium and Magnesium Alloys by the R.A.E. Dichromate Process. H. G. Hopkins. *Journal Institute of Metals*, Vol. 57, July 1935, pages 365-368, Advance Copy No. 710. Protective films, in general, yielded diffuse diffraction rings. It was concluded that the films consist of very small crystals orientated at random. A tentative suggestion is that the film consists of pseudomorphic MgO with a simple hexagonal structure. In some samples the rings were consistent with a hexagonal structure with a = 2.99 A.U. and axial ratio = 1.55. JLG (8f)

How to Select Paints for Gasworks Plant. David E. Roe. *Gas Industry*, Vol. 12, Mar. 1935, pages 150-151. The highly corrosive conditions prevailing in gasworks and the requirements to be met with by paints are pointed out. States that Al has proved very suitable as it combines the properties of resistance to chemical corrosion and general durability with high reflecting power. WH (8f)

Electrolytic Hardening of Pistons (Elektrolytische Härtung von Kolben). Otto Steinitz. *Deutsche Motor Zeitschrift*, Vol. 12, June 20, 1935, pages 105-106. Discusses the patent situation covering the anodic oxidation of Al and the coating of Al to improve its corrosion resistance. Reference is made to the following German patents in this field 452 886, 530 018, 550 285, 72 240, 366 661, 412 020, 523 643, 548 633, 604 443, 467 843, 538 879. WH (8f)

Anodic Oxidation of Aluminum and its Alloys. S. Wernick. *Metal Cleaning & Finishing*, Vol. 6, Nov. 1934, pages 573-577. See *Metals & Alloys*, Vol. 6, July 1935, page MA 289L/9. GBH (8f)

Reconditioning Lines in Salt Marsh Districts. L. E. Bredberg. *Oil & Gas Journal*, Vol. 33, Jan. 3, 1935, pages 8, 36. Details of reconditioning Atlantic Pipe Line Co. 6-10 inch pipe line at Morris and Cummings Cut at Stedman Island near Corpus Christi. VVK (8f)

Holder Painting. J. B. Boniface. *Gas Age-Record*, Vol. 75, Apr. 13, 1935, pages 365-368. Part of Subcommittee Report presented before the New Jersey Gas Association at Camden, N. J., Mar. 28, 1935. Discusses cleaning and application of paints for gas holders as well as durability of various types of paints. VVK (8f)

A Review of the Theories of Adherence of Sheet Steel Enamels. M. J. Bahnsen. *Enamelist*, Vol. 12, Sept. 1935, pages 16-17, 64. A review of various theories for explaining the action of Co or, to a less extent, Ni on the enamel frit in improving and even making possible the adherence of enamel on sheet steel. Ha (8f)

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9. TESTING

9a. Inspection & Defects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

Detection of Thin Spots in Galvanized Coatings (Nachweis von Undichtigkeiten in Zinküberzügen auf Stahl). G. GARRE. *Archiv für das Eisenhüttenwesen,* Vol. 9, Aug. 1935, pages 91-94. The various methods which have been used for detecting pinholes and thin spots in Zn coatings are discussed. An electrolytic method is recommended in which the sample is made the anode in an aqueous K ferrocyanide solution containing 20 g. K ferrocyanide, 1 g. Mg sulphate, 500 cc. water. The porosities show up as blue spots after a few seconds treatment.
SE (9a)

Determination of Origin of Longitudinal Cracks on the Surface of Finished Stock. A. I. NACHALNI & Z. N. RAFALOVITCH. *Domez,* No. 7, 1935, pages 17-26. In Russian. Two contiguous sides of an 0.1 C steel ingot were drilled with 3 and 5 mm. diameter holes 18-20 mm. deep and located in a definite pattern. The ingot was rolled into a 130 mm. round after a proper soaking. The cracks observed on the finished rod and seen after pickling it showed that on the round bar only one hole on the side of the original ingot formed a crack perpendicular to the surface of the bar, the rest being located at an angle. Microscopic examination indicates freedom from liquation around artificial cracks but a certain amount of decarburization connected with the formation of fine oxide inclusions was observed. Holes located in any position on the surface of the ingot gave this effect. The length of seams so produced on the round billets was less than one meter so that a continuous seam on them cannot be associated with the presence of blow holes, to which these holes correspond.
(9a)

New Methods of Inspection Speed Up Output of Small Automobile Parts. F. L. PRENTISS. *Iron Age,* Vol. 136, July 25, 1935, pages 21, 80, 82. Describes method used by the National Acme Co., Cleveland for inspecting of front and rear housings or end plates for starting motors. Inspection equipment includes a chronolog. Housings are Al die castings machined to close limits.
VSP (9a)

A New Small X-Ray Apparatus (45 kv.) for Fine-Structure Examination (Eine neue Kleinröntgeneinrichtung (45 kv.) für Feinstrukturuntersuchungen). H. J. ZIMMERMAN. *Siemens-Zeitschrift,* Vol. 15, Sept. 1935, pages 474-476. A portable arrangement for diffraction work with protection for the operator is described.
Ha (9a)

Action of Gas Reducers on Copper Contaminated with Oxide (L'Action des Gaz Reducteurs sur les Cuivres Souillés d'oxydule). M. ARTIGNAN. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 575-578. Includes discussion. Causes of fissures on Cu plate for locomotive fire boxes are studied. They are due to the presence of oxides; the contact at high temperature with a hydrocarbon, H, or CO atmosphere caused the fissures. Amount of oxide should not exceed 0.030%.
MAB (9a)

Growth in Hydrogen of Metals and Alloys Containing a Little Oxide (Sur le Gouflement dans l'Hydrogène des Métaux et Alliages Contenant un Peu d'Oxyde). GUICHARD, CLAUSMANN & BILLON. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, page 588. Certain metals are subject to growth or deep fissures. These phenomena are due to the presence of oxides in the metals. The H penestrates by diffusion, reducing the oxide and forms an aqueous vapor which acquires a considerable amount of pressure, enough to dislodge the crystals in the metal. Many examples.
MAB (9a)

Investigation of X-ray Fluorescent Screens (Untersuchungen an Röntgenleuchtschirmen). R. BERTHOLD, N. RIEHL & O. VAUPEL. *Zeitschrift für Metallkunde,* Vol. 27, Mar. 1935, pages 63-65. The use of fluorescent screens for the radiographic examination of metals is desirable because of the rapidity of the method, but is less favored than photographic recording because of the relatively poor definition and low intensity of the image formed. Seven makes of screens, 3 of $ZnS + CdS$, 3 of $CdWO_4$ and 1 of $ZnSiO_4$, were examined to determine what factors control the discernibility of the image. It is concluded that: (1) discernibility increases with light intensity reaching a limit beyond which further light intensity adds neither to the ease of perception nor the detail which can be observed, (2) resolution of the image is dependent upon the grain size of the screen, the finer the grain the greater the resolution, (3) resolution is reduced by scattering in thick screens and by white or colored paper backings (but the elimination of this effect by using a thin screen on black paper reduces the intensity of the image by about 30%, sufficient to cancel the advantage obtained), (4) screens giving a green or yellow green fluorescence give greater discernibility than those yielding blue light, (5) all screens give a linear response to intensity changes within the working range of intensities, and (6) the afterglow effect is not troublesome if the intensity falls to 3% of the initial value in 1 second. The influence of specimen thickness upon resolution was studied by determining the minimum size of wire which can be detected on the screen when accompanied by plates of varying thickness. Graphs are given for: (1) plate thickness vs. minimum detectable wire diameter for Al and steel, (2) screen intensity vs. minimum detectable wire diameter and (3) screen intensity vs. quality of X-rays.
FNR (9a)

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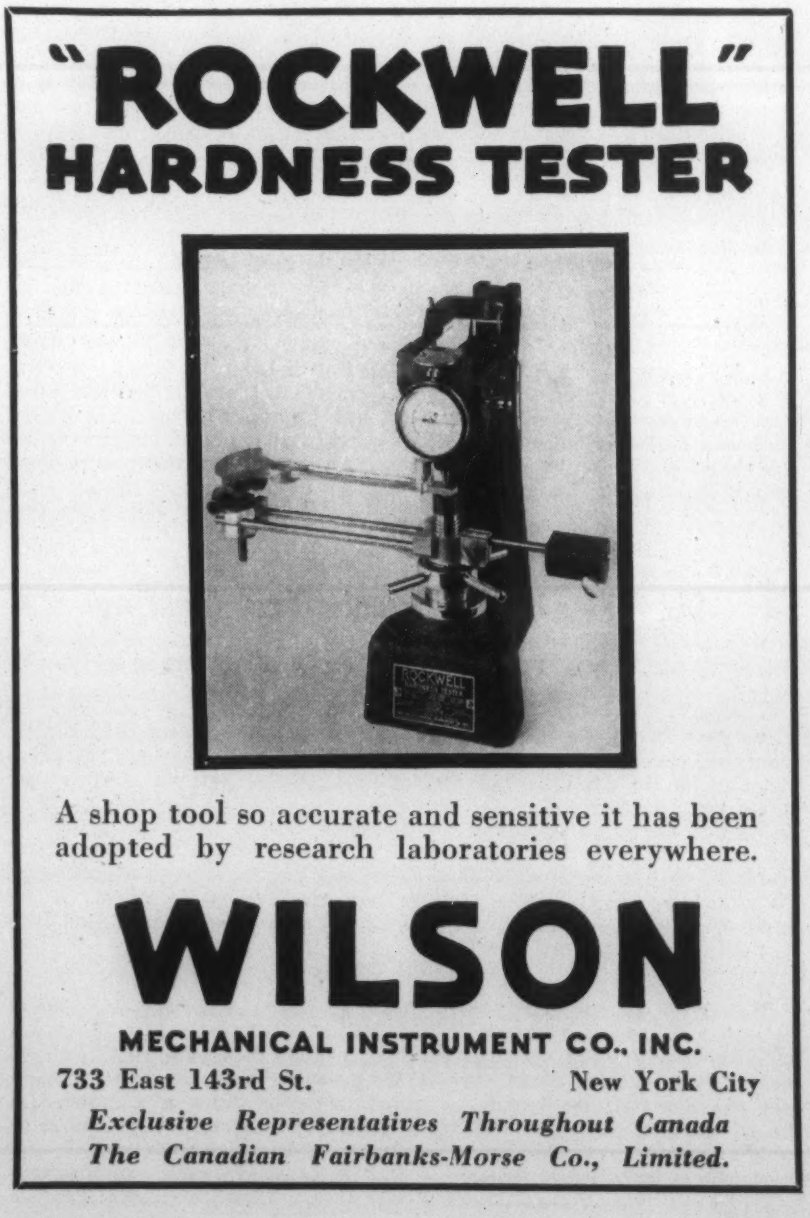
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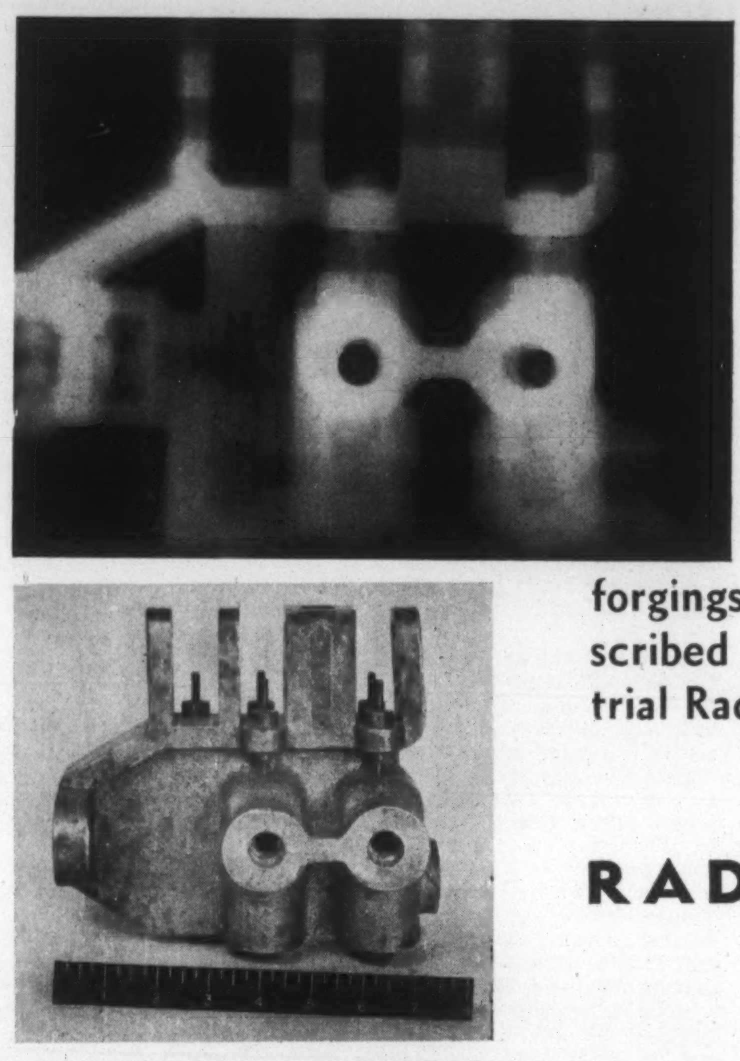

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Spark Testing. *Iron Age*, Vol. 136, Sept. 26, 1935, pages 32-33, 36; Oct. 3, 1935, pages 22-24. An illustrated review of the spark characteristics of important S.A.E. steels. Describes spark characteristics of C-Mn and C-Mn-Ni steels and steels containing Ni, Cr, Mo, W and V. Author claims that spark testing is an economical procedure for sorting mixed grades of steel and also finds extensive use in preventing various grades from becoming mixed. Practice and skill are essential to success. VSP (9a)

Magnaflux Inspection for Cracks and Seams. *Iron Age*, Vol. 136, Sept. 26, 1935, pages 40-41, 143. Describes the Magnaflux instrument used for testing steels for surface crack and seams. VSP (9a)

Examination of the Surface of Tinplate by an Optical Method. W. E. Hoare & Bruce Chalmers. *Iron & Steel Institute Advance Copy* No. 9, Sept. 1935, 8 pages; *Iron & Coal Trades Review*, Vol. 131, Sept. 20, 1935, pages 429-430. The surface of tinplate was examined by an optical method involving the formation of interference fringes between an optical flat and the tinned surface. The method enables a distinction to be made between hollows and reliefs in the surface, and the depths of irregularities can be determined by counting the fringes under visual observation. Sections of some typical irregularities are plotted on an enlarged scale. JLG + Ha (9a)

■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

Materials Testing. Irving H. Cowdrey & Ralph G. Adams. 2nd Edition. John Wiley & Sons, Inc., New York, 1935. Cloth, 6 x 9 inches, 144 pages. Price $1.75. In this little book the authors accomplish just what they set out to do, which was to provide a textbook for beginning students. They have described, briefly and simply, the fundamentals of mechanical testing. It is not a book for advanced students, nor for the engineer with special problems in the testing of materials. It is somewhat elementary to serve as a text for students of metallurgy. In general the selection of material has been excellent; in the opinion of the reviewer, a little space should have been devoted to endurance tests, both creep and fatigue, which have not been treated. M. Gensamer (9b) -B-

Methods of Carrying Out a Bend Test. L. W. Schuster. *Mechanical World & Engineering Record*, Vol. 47, May 17, 1935, pages 470-472. Speeds of 0.025-20 in./sec. do not affect the testing results of bending steel specimens provided that shock is absent. The following bending tests are fully discussed: (a) free bend test, (b) bending on supports solely by means of a former, (c) bending on a mandrel, (d) bending by pressing the specimen into soft metal with a former, (e) bending by the application of a pure bending moment, (f) bend tests of fusion welded joints. WH (9b)

Abrasion at High Temperature. Yoshiro Fujii. *Tetsu-to-Hagane*, Vol. 21, Aug. 25, 1935, pages 656-660. In Japanese. By use of a newly constructed abrasion tester, the test of various materials which are used as cylinder liner and piston ring of Diesel engine was carried out in lubricating oil at 200°. In the case of cast iron with cast iron, the loss of weight was 50 times that at room temperature. In the case of 2 nitrided steels and 7 C steels (0.1-0.9% C), the test was carried out under a load of 50 kg./cm^2 and the best result was obtained from nitrided steel and 0.5-0.6% C steel. The loss of weight in this case reached only 1/10-1/30 of the cast iron pair. Nitrided steel with cast iron did not give good results. The temp. of the cylinder wall was less than 200°; lubricating conditions were good. TS (9b)

The Resistance of Spring Steels to Repeated Impact Stresses. G. A. Hankins & H. R. Mills. *Engineering*, Vol. 139, June 7, 1935, pages 611-613; *Heat Treating & Forging*, Vol. 21, July 1935, pages 322-326. Paper read before the Iron & Steel Institute. See *Metals & Alloys*, Vol. 6, Sept. 1935, page MA 368L/8. LFM + MS (9b)

Standardization of a Small Impact Sample (Zur Normung einer kleinen Kerbschlagprobe). R. Mailänder. *Stahl und Eisen*, Vol. 55, July 11, 1935, pages 749-754; July 18, 1935, pages 779-785. Gives the results of an extended study on standardization of the impact test by the German Society for Testing Materials and the Verein deutscher Eisenhüttenleute. Contains data covering 9000 tests on different sized steel specimens with various notches, given different heat treatments, and tested over the temperature range at which the sharp drop in impact resistance occurs. The large German impact specimen is 30 x 30 x 160 mm. A smaller test bar 10 x 10 x 55 mm. with a drilled notch 3 mm. deep and 2 mm. wide is recommended as giving fairly good comparative values with the larger specimen and as being very similar to the specimens used in other countries. SE (9b)

A New Method and Machine for Dynamic Hardness Testing. W. M. Patterson. *Preprint, American Society for Testing Materials*, June 1935, 10 pages. This paper points out the need for a reliable hardness scale with definite physical units of equal value throughout the scale. It comments briefly on previous work in this field showing reasons for the inadequacy of past methods. A new machine, the Ballentine hardness tester, for dynamic hardness testing is described and the development of a scale fulfilling the desired conditions is explained. Test data are given on alloys of Pb, Cu and Al, cast iron and soft and medium-hard steels. The reproducibility of results to be expected with the method in laboratory and production work is estimated, and a brief discussion of the advantages and particular field of use of the machine is given. VVK (9b)

On the Measurement of Very Short Time Intervals IV. Tsumeto Ikebe & Genzo Isobe. *Bulletin Institute of Physical & Chemical Research, Tokyo*, Vol. 14, July 1935, pages 525-569, in Japanese; *Scientific Papers & Abstracts of the Institute of Physical & Chemical Research, Tokyo*, Vol. 27, July 1935, page 40. In English. Pursuing previous research on cinematography of vibration and stress propagation, the measuring apparatus was tested by a reconstructed Helmholtz pendulum. WH (9b)

The P-F Characteristic of Steel. B. F. Shepherd. *Pennsylvania State College, Bulletin* No. 18, 1935, pages 59-98. A set of martensitic fracture grain standards was prepared and given consecutive numbers. By comparison, the grain of a steel is estimated to about ¼ number. Stock is forged to 1″ round, annealed at 1325° F., machined to ¾″ round, and oil-quenched from 1600° F. after holding the pieces at this temperature for 40 min. Samples held at 1450°, 1500°, 1550° and 1600° F. for 30 min. in an electric furnace are quenched in a standard vertical jig flushed with 10% brine at room temperature. The pieces are notched, broken by transverse impact, and compared with the standard. One half of the fractured specimen is polished and hardness penetration measured to the nearest ½ of 1/64″; the result is expressed as the numerator of such a fraction. The P-F characteristic is 8 numbers, the first 4 being penetrations and the last 4 fracture grain size for 1450°, 1500°, 1550° and 1600° F. specimens in rotation. Type 1 steel is stable or insensitive to increase in hardening temperature, with regard to both P and F; type 3 is directly opposite; type 2 is intermediate. There can be combined, for example, type 2-1, the first number referring to P and the second to F. Segregation has an influence on hardenability. Hardenability is a heat characteristic. P-F characteristic is due to the melting reactions and not to ingot size, temperature of pouring, etc. A high temperature oil-quench before final hardening to remove structural irregularities was necessary for definite control of the P-F test. Heats of type 1 characteristic were rather insensitive to changes in prehardening structure; type 3 heats showed a marked difference in the P-F characteristic between pearlitic and sorbitic prehardening structure. The gradation between martensitic and troostitic zones is much more abrupt with a sorbitic prehardening structure than with the pearlitic prehardening structure. There is a distinct tendency for type 3 steels to have a more uniform hardness in the hardened zone than type 1. AHE (9b)

The Hardness Testing of Light Metals and Alloys. R. L. Templin. *Preprint, American Society for Testing Materials,* June 1935, 15 pages; *Iron Age,* Vol. 135, June 27, 1935, pages 21-26. One of the most used tests in the commercial inspection of metals is the hardness test, of one form or another. The success attained in applying the hardness tests to ferrous metal products has quite naturally suggested similar uses for non-ferrous products. A critical review of the factors affecting the more common hardness tests, however, reveals effects of different magnitude in some important instances, which would seem to mitigate seriously against the satisfactory use of the hardness tests for many of the light alloys. The presence of the oxide films on Al alloys, and the alloys coated with relatively thin layers of other different alloys are examples of the more conspicuous difficulties. The effects of other factors such as load-penetrator-time relationships, anvil or support, size and preparation of specimen are quantitatively quite different than in the case of ferrous metals. Likewise the relationships between different kinds of hardness and between hardness and the other static properties of the light alloys are quantitatively different from those obtained in ferrous metals. With these facts in mind the application of the hardness tests to general classes of commercial light-alloy products is discussed. VSP + VVK (9b)

Influence of the State of Stress on the Plasticity of Metallic Materials (Einfluss des Spannungszustandes auf das Formänderungsvermögen der metallischen Werkstoffe). Albert F. Maier. VDI Verlag, Berlin, 1935. Paper, 5¾ x 8¼ inches, 47 pages typescript. Price 5 RM. The author has investigated the effect of three-dimensional systems on the plastic deformation of tubes and cylinders. He finds that brittle fractures may result from non-homogeneous three-dimensional states of stress, in material which is quite plastic under simple uniaxial loading, and finds that the average normal stress, $\sigma_m = 1/3(\sigma_1 + \sigma_2 + \sigma_3)$ is a significant factor in these cases. If σ_m is greater than σ_m for simple tension tests, the material will be less ductile, while if σ_m is less, as in certain cases of tension and compression testing under the application of hydrostatic pressure, the material will suffer a greater deformation before rupture. He has also carried out fatigue tests on tubes subjected to internal pressure, and finds that for both brittle and ductile materials the endurance limit for circumferential stresses is independent of the longitudinal stress. This work should be of considerable interest to many concerned with such problems as the failure and collapse of tubes under pressure, and is another step on the road to a complete theory of failure of ductile materials under stress. M. Gensamer (9b) -B-

The Overstraining of Mild Steel. J. Muir. *Iron & Coal Trades Review,* Vol. 130, Apr. 26, 1935, page 704. See *Metals & Alloys,* Vol. 6, July 1935, page MA 290R/10. Ha (9b)

Hardness Testing of Nitrided Steel. John H. Hruska. *Iron Age,* Vol. 136, Sept. 26, 1935, pages 22-23, 26-28, 30, 58. Compares some of the work of various investigators including vast amount of the author's own work. Scratch, Rockwell, Vickers, pendulum and scleroscope tests, and their usefulness are discussed. Tabulates some results of tests. VSP (9b)

Inexpensive Weld Tests. R. B. Lincoln. *Welding Engineer,* Vol. 20, Oct. 1935, pages 26-28. Describes some simpler and cheaper ways of testing of welds in cases where conditions do not require the code tests. They can be used also as a preliminary to the code tests and check on work of new or distrusted operators. A schedule of rating is suggested. Ha (9b)

Testing Engineering Materials. V. Hardness Tests. J. Trickett. *Mechanical World & Engineering Record,* Vol. 48, July 19, 1935, pages 55-56; July 26, 1935, pages 81-83, 87. Hardness testing is one of the least understood in its results. It is nevertheless a most useful test for comparison but the machine and method must be selected for the purpose. The Brinell and Herbert hardness testers are described. An apparatus is shown suited for the determination (pendulum tester) of materials at elevated temperatures. Another interesting picture reveals the hardness distribution in a chip of stainless steel cut in a lathe. It is noteworthy that the hardness at the end of the chip induced by the tool is almost twice as high as in the original metal. Some materials work-harden much more quickly than others. After 2 passes of the ball in the pendulum time-work-hardening test, the maximum induced hardness of a piece of hard tool steel will be found to be 89 as against an original hardness of 71. Contrary to this behavior, Mn steel, with original hardness of 21, needs 10 passes of the ball before the maximum hardness of 57 is reached. Once the maximum has been attained, the induced hardness figure declines. The usefulness of dynamic hardness testers is discussed critically. WH (9b)

■ 9c. Fatigue Testing ■

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

The Strength of Metals Under Combined Alternating Stresses. H. J. Gough *(British) Institution of Mechanical Engineers,* Advance Copy, Nov. 1935, 52 pages. Using a specially designed fatigue testing machine for producing any desired combination of flexural and torsional alternating stress, a comprehensive study of three materials has been made. Two of the materials were ductile steels, the third metal was brittle cast iron. The results of the tests made on the ductile steels follow fairly closely the Von Mises-Hencky (maximum shear-strain energy) theory and can be expressed by the formula $f^2/f^2_1 + q^2/q^2_1 = 1$, in which f and q refer, respectively, to the applied bending and torsional stresses at the fatigue limit of the combination, while f_1 and q_1 denote respectively the fatigue limits under simple bending and pure shear. The author states that the cast iron followed the maximum principal stress theory of strength, and notes that the planes of fracture were such as would be expected if that theory held. A description of the testing machine is given, and data of auxiliary mechanical and metallographic tests of the material. The cast iron showed the remarkable endurance ratio of 0.87. (Note by the abstractor; the test results plotted in this paper seem to show that the results for the cast iron fell between results in accordance with the maximum principal stress theory and results in accordance with the maximum principal strain theory. The direction of maximum principal stress and of maximum principal strain are the same, so that the direction of planes of fracture in a specimen could not be used to distinguish between the maximum principal stress theory and the maximum principal strain theory). HFM (9c)

Work of F. Regler on Material Testing by Means of X-Rays (Die Arbeiten von F. Regler zur Werkstoffprüfung mit Röntgenstrahlen). F. Wever & H. Möller. *Archiv für das Eisenhüttenwesen,* Vol. 9, July 1935, pages 47-55. A controversy between the authors and Regler indicating that the latter's proposed method of determining the onset of fatigue failure by observing the broadening of the X-ray spectrum lines is ill founded. SE (9c)

Fatigue Tests and Non-Destructive Tests on Welds. G. A. Hankins. *Welder,* Vol. 7, May 1935, pages 571-574. A brief summary of fatigue experiments on weld metals and welded joints carried out at the National Physical Laboratory is given. Due to presence of blowholes, inclusions, etc., the intrinsic fatigue strength of the actual weld metal is definitely lower than that of mild steel. The fatigue strength of fillet and butt welds is much lower than would be anticipated from ordinary static tests on the joints; a normal static tensile test gives no indication of the probable strength under repeated loads. Stress concentrations arising at the roots and toes of fillet welds and reinforced butt welds, and uneven stress distribution along the length of fillet welds are of great importance for joints under repeated loads. The high-grade covered electrode appears much superior to the bare wire electrode for butt and fillet welds for repeated loads. Reliable fatigue tests are still wanting. Non-destructive tests are reviewed. Ha (9c)

The Question of Metal Fatigue. S. V. Serensen. *Vestnik Metallopromishlennosti,* Vol. 14, Dec. 1934, pages 54-58. In Russian. Brief survey of the present conception of fatigue failures and their importance in industrial life. (9c)

Development of Fatigue Tests for Aluminum and Its Light Alloys (Sullo sviluppo delle prove di fatica su l'alluminio e le sue leghe leggere). A. von Zeerleder. *Alluminio,* Vol. 4, Mar.-Apr. 1935, pages 95-105. An outline of fatigue tests used in testing Al and its alloys. Results are not yet easily reproducible, and great care must be taken to eliminate traces of impurities, as these affect the results very markedly. AWC (9c)

Fatigue Tests of Butt Joints in Mild Steel and High Tensile Steels. J. Orr. *Mechanical World & Engineering Record,* Vol. 47, Apr. 19, 1935, pages 373-374. See *Metals & Alloys,* Vol. 6, June 1935, page MA 242R/8. WH (9c)

"Test Cases" of Machine Failure. F. L. Everett. *Mechanical World & Engineering Record,* Vol. 47, May 24, 1935, pages 491-493. Paper presented before the American Society of Mechanical Engineers. See "Stress Analysis of Failure in Machine Parts," *Metals & Alloys,* Vol. 6, July 1935, page MA 291R/7. WH (9c)

Bending Endurance Strength of Copper and Aluminum Wires (Biegewechselfestigkeit von Kupfer- und Aluminiumdrähten). W. Friedmann. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Aug. 24, 1935, pages 1046-1047. Method of testing on the Föppl-Heydekampf machine is described and particular care was taken to avoid breaking of the wires where they were gripped. This danger was greater in brittle than in soft wires. Tensile strength, elasticity modulus and bending endurance strength are given for Cu and Al wires of 2.1-2.8 mm. diam. The endurance strength for welded wires was 50-70% of that of the solid wires. Ha (9c)

Simple Filters for Isolating Lines in the Mercury Spectrum. A. J. Maddock. *Journal Scientific Instruments,* Vol. 12, July 1935, pages 218-219. Simple filters, consisting mainly of solutions of inorganic compounds, are described for isolating the strongest lines in the mercury spectrum from 3022 to 5780 A.U. and one transmitting chiefly 2652 A.U. RAW (9c)

The Effect of Heavy Oils and Greases on the Fatigue Strength of Steel Wire. R. Goodacre. *Wire & Wire Products,* Vol. 10, Oct. 1935, pages 473-475. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 408R/1. Ha (9c)

Low-temperature Fatigue Tests. W. D. Boone & H. B. Wishart. *Foundry Trade Journal,* Vol. 53, Aug. 15, 1935, page 122. Extended abstract of a paper read before the Annual Meeting of the American Society for Testing Materials. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 331L/3. AIK (9c)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Crystal Structure and Composition of Intermediate Phases Present in Iron-tungsten and Iron-molybdenum Alloys (De intermediära fasernas kristallbyggnad och sammansättning i järn-volfram- och järn-molybdenlegeringar). HARRY ARNFELT & A. WESTGREN. *Jernkontorets Annaler*, Vol. 119, May 1935, pages 184-196. Summary in English. Using the X-ray data of Arnfelt (*Carnegie Scholarship Memoirs* of Iron & Steel Institute, Vol. 17, 1928, page 1) the crystal structure of the intermediate phases present in Fe-W, and Fe-Mo systems has been determined. The unit cell of the hexagonal phase Fe_2W has the dimensions $a = 4.727$ A.U.; $c = 7.704$ A.U. The phases usually denoted by the formulas Fe_3W_2 and Fe_3Mo_2 are rhombohedral, the edges being respectively 9.02 and 8.97 A.U., and the angles 30° 30.5′ and 30° 38.6′. In both the unit cell consists of 13 atoms, so the above formulas are incorrect. If the 2 kinds of atoms are not statistically distributed upon the lattice points, the only possible divisions falling within the homogeneity ranges are represented by Fe_7W_6 and Fe_7Mo_6. Determination of the atomic grouping verifies this conclusion. Fe_7W_6 is not stable at low temperatures but has a low rate of decomposition, but the Fe_7Mo_6 phase persists for at least one month at 500°-700° C. HCD (10)

Directionality in Some Annealed Alloys. R. G. JOHNSTON. *Metal Industry*, London, Vol. 45, Dec. 14, 1934, pages 560-562; Dec. 21, 1934, pages 588-590; Dec. 28, 1934, pages 613-614. The author describes this paper as "of the nature of a preliminary survey and report on a region calling for detailed study rather than a detailed study itself" in which he has endeavored to seek the causes for directional properties that are natural to sound metal. Directional is defined as "the character or property of a metal or alloy which varies according to the direction in which it is measured with respect to the sheet or strip." The method employed was borrowed from the science of statistics and has been described in earlier papers published in this magazine. Micrographs of annealed brass and 96/4 phosphor bronze were examined. The maximum diameters of the grains and twinnings were measured and the results analyzed. The plotted results showed that the "index of directionality" or preferred orientation lay across and not along the direction of last cold working. The author then gives his theory of why the preferred orientation lies across the direction of last cold working. He believes that nuclei at the corners of the old distorted grains are the beginnings of the new grains and that, during growing, the new grains would first meet interference from similar grains in the direction of the last rolling before the anneal. The inference drawn is that if the grain boundaries are stronger than the grain bodies, the higher tensile values, when testing, should be obtained in the direction of rolling than across it. The few tests made confirm this. The paper is well illustrated. HBG (10)

Influence of Lattice Distortion on Diffusion in Metals. V. G. MOORADIAN & JOHN T. NORTON. *Metals Technology*, Sept. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 649, 9 pages. Samples of Cu-Ni, Cu-Au, Ag-Au, and Ni-Co were prepared by electrolytic deposition of alternate layers of the metals. They were heated to different temperatures for a period of 24 hr. and examined by X-ray diffraction. The diffraction patterns indicated that diffusion did not take place until lattice distortion of the original samples had been removed, thereby indicating that strain did not promote diffusion. JLG (10)

Singular Type of Unstable Solid Solution with Anomalous Lattice constants (Ein besonderer Typus von unbeständigen Mischkristallen mit anomalen Gitterkonstanten). G. NATTA. *Naturwissenschaften*, Vol. 23, July 26, 1935, pages 527-528. Thin metallic films containing Pt may be obtained on polished Cu and Ag by the use of a very dilute solution of $PtCl_4$. Subsequent attack by HNO_3 may produce a film whose thickness is approx. 10^{-6}cm. Such films consist of a solid solution of the 2 metals whose structure and composition depend upon the ratio of the atomic radii of the precipitated and precipitating metals. If this ratio is less than one the results are quite different than when it is greater than one. The lattice constant of a film of Pt on Cu is between those of Pt and Cu. This constant depends upon the film thickness, the concentration of the etching HNO_3 and upon the conditions of precipitation. Often a definite concentration of 30 or 50% Pt is found in these films. Heating a 30-70% Pt film on Cu produces a structure of lower symmetry. When Pt is precipitated on Ag the lattice constant of the film is 4.07-4.08 A.U., practically the same as for Ag. This film is entirely insoluble in 20-30% HNO_3. On remaining at room temperature for 2-6 days, heating at 80-90° C. for a few hours or at 700° C. for a few sec. produces a film of smaller lattice constant (3.99-4.03 A.U.). That a solid solution of 50% Pt in Ag can exist with practically the same lattice constant as pure Ag is remarkable. A change of color often accompanies this contraction of the lattice. All of the structure determinations were made by electron diffraction methods. HAS (10)

Solubility of Oxygen in Solid Cobalt and the Upper Transformation Point of the Metal. A. U. SEYBOLT & C. H. MATHEWSON. *Metals Technology*, Sept. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 642, 17 pages. A possible P-T-X diagram between Co and CoO is given and discussed. To determine the solid solubility of O in Co specimens of Co were heated in O_2 or air at temperatures from 600° to 1200° C. until the O content of the interior became constant. There was a marked discontinuity in O solubility at 875° C. This represents the transformation of the face-centered cubic lattice of Co to the close-packed hexagonal form stable at higher temperatures. Electric resistance measurements also indicated a transformation in the neighborhood of 875° C. The most probable transformation temperature of O-free Co was placed at 850° C. In the diagram presented there is a reaction horizontal at 875° C. At this temperature the high-temperature modification of Co is saturated with 0.006% O and the intermediate-temperature modification is saturated with 0.020% O. The solubility of O in Co decreases rapidly with decreasing temperature for both modifications. The laws of dilute solution were found to generalize the data on solubility, thereby indicating that true equilibrium conditions had been obtained. 14 references. JLG (10)

X-ray Study of Recovery and Recrystallization of Aluminum Single Crystals. N. SELJAKOW & E. SOWS. *Nature*, Vol. 136, May 4, 1935, pages 764-765. Back-reflection Laue photograms of Al single crystals show asterism after 5 to 16% deformation. Subsequent annealing changes the intensity distribution in the streaks on the photograms. Some crystals recrystallize into single crystals of new orientation. CSB (10)

A Study of the Molybdenum-carbon System. W. P. SYKES, KENT R. VAN HORN & C. M. TUCKER. *Metals Technology*, Sept. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 647, 14 pages. The Mo-C system was studied by thermal, microscopic, and X-ray diffraction methods. The solid solubility of C in Mo at low temperatures was found by microscopic and X-ray methods to be between 0.07 and 0.09%. The existence of a phase of variable composition, but approximately Mo_2C, was confirmed. The eutectic between this phase (β) and Mo was found to be at approximately 1.8% C and 2200° C. A third phase of higher C content was observed both microscopically and by X-ray diffraction. It is possible, but not established, that it includes the concentration 11.1% C (MoC) and is analogous to WC. This high-C phase was observed in alloys containing 5.36 or more C that had been heated to a high temperature. 5 references. JLG (10)

Quenching Stresses and Precipitation Reaction in Aluminum-magnesium Alloys. R. M. BRICK, ARTHUR PHILLIPS & A. J. SMITH. *Metals Technology*, Sept. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 650, 16 pages. Al-rich Al-Mg alloys were heat treated in the form of powder and as rods of different diameters. Strain was measured from the X-ray diffraction patterns. The stresses in the rods seemed to be a function of the difference between the parameter and that of pure Al as related to the actual concentration of solute atoms, either Cu or Mg. The maximum stress in the high-Mg alloys is limited by the strength of the alloys. The precipitation reaction in Al-Cu or Al-Mg alloys proceeds at about the same rate for fully saturated solutions. However, where the same concentration of solute atoms, 1.8%, is precipitating, the Cu alloy transforms in about 20 min. as compared with 1000 hr. required by the Mg alloy. The difference is caused in part, at least, by difference in diffusion rate of the relatively large Mg atoms as compared with Cu atoms. In the Al-Mg alloys reheated in the range 175° to 300° C. the hardness peak was observed after precipitation was entirely complete. 9 references. JLG (10)

X-ray Source in a Single Crystal (Röntgenlichtquelle im Einkristall). G. BORRMANN. *Naturwissenschaften*, Vol. 23, Aug. 23, 1935, pages 591-592. This is a note to be followed by a more complete publication in *Annalen der Physik*. The experimental conditions are that the single crystal must be generally irradiated, and the sample-film distance must be several centimeters. A back-reflection photograph of a single-crystal Cu sphere is shown on which 3 or 4 line systems are found. These lines are formed by the Cu-Kα radiation formed within the crystal and diffracted from 4 existing surfaces of the types (111), (222), (220) and (311). HAS (10)

Notes on the Crystallization of Copper. ALDEN B. GRENINGER. *Metals Technology*, Sept. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 643, 12 pages. Metal crystals may have a macromosaic and a micromosaic structure. The former may often be seen on Cu crystals if they are examined carefully with critical illumination, but back-reflection Laue X-ray patterns give more definite information. Micromosaic structure is of too fine a scale to produce splitting of Laue spots but is evidenced by a broadening of the diffracted beam. Polycrystals of Cu were produced by solidification in crucibles and the resulting orientations of the crystals determined. These orientations are discussed and it is concluded that most macrograins in polycrystals are secondary; that is, their nuclei are derived from disturbances in the primary grain lattice. Disturbances occurring during and subsequent to crystallization may be small and form macromosaic structures or they may go to completion and form twins. They may stop somewhere between these extremes to form a near-parallel, near-twin, or "random" arrangement. JLG (10)

Twinning in Alpha Iron. A. B. GRENINGER. *Nature*, Vol. 136, June 1, 1935, page 916. Twinning of the (112) type occurs in pure Fe either from slow cooling through the critical range or from deformation followed by annealing below the critical range. The author believes that Widmanstätten structures in Fe and steel "are the result of twinning and the macromosaic lattice movements rather than of the crystallographic uniformity of the γ-α transformation process as was proposed by Mehl and Smith." CSB (10)

Native Iron from West Greenland. H. CARPENTER. *Nature*, Vol. 136, July 27, 1935, page 153. Microstructure and analysis of native iron from Ovifak, Disco Island, West Greenland, are discussed. It is concluded that the Widmanstätten structure of proeutectoid cementite resulted from slow cooling after C had been introduced from the combustion of lignite beds, and that the iron is not meteoric in origin as some have maintained. CSB (10)

Grain Size and Its Influence on the Manufacture of Steel Wire. B. L. McCARTHY. *Wire & Wire Products*, Vol. 10, Sept. 1935, pages 359-373. The factors influencing the uniform quality of steel for wire drawing are discussed, in particular the inherent properties of heats of steel and their influence on the reactions which occur as a result of heat treatment of high C steel wire. A method of grading heats of steel other than by chemical analysis has been developed; viz., the McQuaid-Ehn grain size test. The absorption of C in this treatment is sufficient to increase materially the C content in the case of the specimen thereby producing a hyper-eutectoid area containing free cementite. According to the grain size as counted in the micrographs the steels are graded for further use in wire drawing. The influences of heat treatment, cold working, and plastic deformation in the drawing process are discussed and illustrated in microstructures. The application of this method to control the melting process and the microstructure by heat treatment is described. 11 references. Ha (10)

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The Metallography and Heat Treatment of Iron and Steel. Albert Sauveur. 4th Edition. McGraw-Hill Book Company, New York, 1935. Cloth, 7 x 10½ inches, 531 pages. Price $8.00.

A fourth edition of this book, which first appeared in 1912, brings the distribution into its 19th thousand. That is, something like 800 metallurgists per year have added this classic to their libraries and have gained a better understanding of the subject from Sauveur's depth of knowledge and clarity of presentation. Many others who do not own the book have access to it. Thus, while Sauveur has educated a few metallurgists at Harvard, he has educated many more through his writings.

With the wide distribution of the preceding editions, the subject matter is well known and needs no detailed cataloging here. The discussion deals primarily with plain iron and steel, alloyed compositions being but briefly dealt with, and is confined almost entirely to the structure and behavior of solid metal with little reference to the liquid state and the effect of melting processes.

This edition has been revised and brought up-to-date in many points, generally being slightly amplified rather than materially changed. The modifications made apply to some of Sauveur's own theories and ideas, as well as to those of others. It is a rare author and educator who is as open-minded as Sauveur. Even so, not much of the previous edition is outmoded. The book is of the type that does not readily become obsolete.

The chief new material in this edition relates to atomic structure and the information gained by X-ray methods. H. W. Gillett (10) -B-

Solubility of the Compound $MgZn_2$ in Aluminum in Solid State at Different Temperatures (Solubilité de $MgZn_2$ dans l'aluminium à l'état solide à des températures diverses). P. J. Saldau & M. I. Zamatorin. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 31-38. See *Metals & Alloys,* Vol. 5, May 1934, page MA 215. NA (10)

Solubility of Aluminum in Magnesium in Solid State at Different Temperatures (Solubilité d'aluminium dans le magnésium à l'état solide en fonction de la température). P. J. Saldau & M. I. Zamatorin. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 21-30. See *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 4. NA (10)

Criterion for the Appearance of Ordered Distribution of Atoms in Metallic Solid-solution Series (Über ein Kriterium für das auftreten geordneter Atomverteilungen in metallischen Mischkristallreihen). H. J. Seemann. *Zeitschrift für Physik,* Vol. 95, July 12, 1935, pages 796-798. Curves are drawn to show the relation of lattice constant to at. % for the alloy series Ag-Au, Ag-Pd, Au-Pd, Au-Pt, Cu-Ni. An attempt is made to show the effect of expanding or contracting lattice with increasing at. % on the attainment of non-uniform or uniform atomic distribution in solid solutions. FHC (10)

Equilibrium Diagram of Mg rich Mg-Mn System. Hachie Sawamoto. *Suiyokwai-Shi,* Vol. 8, Aug. 1935, pages 763-768. In Japanese. Author studied the equilibrium diagram of the Mg-Mn alloys by thermal and microscopic methods and determined one part of the diagram. According to his study, the new phase β was found to be a solid solution of the intermetallic compound, Mg_9Mn, which was formed by the peritectic reaction at 726° C: Liquid $+$ X $\rightleftarrows \beta$; he also found a eutectic reaction at 648° C.: Liquid $\rightleftarrows$ (Mg) $+ \beta$. HN (10)

Boundary of α-phase in the System Copper-cadmium (Limites de la phase alpha du système cuivre-cadmium). S. A. Pogodin, V. I. Miheeva & G. A. Kogan. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 39-48. By microscopic examination of quenched alloys the solidus line of the α-phase (Cu-rich) was determined. The limit of solubility of cadmium in solid Cu is: at 550°—2.8-3.0%, at 525°—2.5%, at 475°—2.1%, at 400°—1.6%, at 250°—1.0-1.2% and at room temperature about 1.0%. NA (10)

Physico-chemical Study of the Alloys of Thallium with Bismuth and Cadmium (Investigation physico-chimique des alliages de thallium avec le bismuth et le cadmium). N. S. Kurnakow & V. A. Ageewa. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 123-134. The diagram of system Th-Bi-Cd was constructed from thermal analysis. Cd is not soluble in the γ-phase of the system Th-Bi. The liquidus of the γ-phase indicates that this phase can be considered as a compound of variable composition. NA (10)

Theory and Use of the Metallurgical Polarization Microscope. Russell W. Dayton. *Rensselaer Polytechnic Institute Bulletin, Engineering & Science Series* No. 50, Feb. 1935, 32 pages. Reprint of Technical Publication No. 593, American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys,* Vol. 6, July 1935, page MA 296L/7. PRK (10)

Alloys of Magnesium. Part III. Constitution of the Magnesium-rich Alloys Containing Aluminium and Cadmium. J. L. Haughton & R. J. M. Payne. *Journal Institute of Metals,* Vol. 57, July 1935, pages 369-380, Advance Copy No. 711. Alloys of Mg containing up to 20% Al and up to 20% Cd were investigated by thermal and microscopic methods. The addition of Cd to Mg-Al alloys depresses the liquidus slightly. On the addition of 20% Cd to an alloy of 80 Mg—20 Al the liquidus is lowered by about 50° C. but the temperature of the Mg-Al eutectic remains unchanged. Cd reduces the solubility of Al in Mg to a small extent. No new phases are found in alloys containing up to 20% of each added element. An abnormal form of precipitation was observed in some of the alloys. This produced microstructures resembling pearlite, but evidence was found to indicate that it resulted from precipitation and not from a eutectoid transformation. 11 references. JLG (10)

Constitutional Diagram of the System Silver-aluminum in the Range 0-10% Al (Diagramme d'état des alliages de l'argent avec l'aluminium contenant de 0 à 10% de poids d'aluminium). N. W. Ageew & D. N. Shoyket. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 59-75. See "The Constitution of the Silver-rich Aluminum-silver Alloys," *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 152. NA (10)

Variations of Resistance with Magnetic Fields in Metal Crystals (Magnetische Widerstandsänderung in Metallkristallen). Max Kohler. *Zeitschrift für Physik,* Vol. 95, June 17, 1935, pages 365-382. The relation is shown between crystallographic orientation, electric resistance, and magnetic field strengths, based largely on mathematical development. FHC (10)

Composition and Crystal Structure of Trigonal Cr and Mn Carbides (De trigonala krom- och mangankarbidernas kristallbyggnad och sammansättning). A. Westgren. *Jernkontorets Annaler,* Vol. 118, June 1935, pages 231-240. The dimensions of the unit cell for Cr carbide are: $a = 13.98$; $c = 4.523$ A.U. and for Mn carbide $a = 13.87$; $c = 4.53$ A.U. On rotation photographs of the latter about the axis (001), the only prism reflections (hko) visible are those with h and k even. The number of atoms in the unit cell must therefore be a multiple of 4, which lends support to the hitherto accepted formula Mn_7C_3, which requires 80 atoms per unit cell. An approximate solution on the basis of this formula represents the observed symmetry so closely that the author has no doubt of its correctness, but since 40 parameters are required and many of these cannot be determined exactly, a rigorous proof is not possible. The data upon which the calculations are based were determined by Westgren and Phragmen. HCD (10)

The Mechanism of the α-γ Transformation of Iron (Ueber den Mechanismus der α-γ-Umwandlung des Eisens). G. Wassermann. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf,* Vol. 17, No. 11, 1935, pages 149-155. Unalloyed low C Fe recrystallizes when heated above the A_3 point, but a regular connection between the orientation of the crystals before and after heating cannot be established. The $\gamma \rightleftarrows \alpha$ transformation of an Fe-Ni alloy with 30% Ni was studied and was found to be reversible, even at repeated transformation. Recrystallization temperature lies above the α-γ transformation temperature so that according to the temperature of annealing the α-γ transformation can take place with or without simultaneous recrystallization. A further investigation of the relation of the α- and γ-phase showed that no agreement exists with the orientation layers of martensite so that a different orientation must be assumed for the transformation into a body-centered cubic phase; the different possibilities for layers to arrange themselves are discussed and a picture representing the transformation of a face-centered cubic lattice (γ) into a body-centered cubic lattice (α) is developed. 26 references. Ha (10)

Kinetics of Precipitation in Al-Mg Solid Solutions (Kinetik des Zerfalls fester Lösungen Al-Mg). M. K. Zacharowa & W. K. Tschikin. *Zeitschrift für Physik,* Vol. 95, July 12, 1935, pages 769-774. Solubility limits of Al in Mg are:

° C.	% Al by weight
150	2.0
218	3.3
300	6.2

Precipitation in cold worked alloy takes 30 minutes at 150° and about 30 seconds at 218° C. FHC (10)

Recrystallization of Cast Aluminum (Rekristallisation von gegossenem Aluminium). H. Röhrig & E. Käpernick. *Aluminium,* Vol. 17, Aug. 1935, pages 411-415. Experiments with commercial Al with small amounts of Si and Fe (less than 0.5%) permit stating that a recrystallization in the cast state takes place if the impurities are converted, at the temperatures employed for annealing, into solid solutions; however, recrystallization does not occur if insoluble compounds remain at the grain boundaries. Below the temperature necessary for dissolving the impurities, recrystallization therefore, does not take place. Ha (10)

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11. PROPERTIES OF METALS AND ALLOYS

Present Status of Supraconductivity Research (Der Stand der Forschung über die Supraleitung). W. MEISSNER. *Elektrotechnische Zeitschrift,* Vol. 56, Sept. 26, 1935, pages 1061-1065. Present views on this subject can be summarized as follows: supraconductivity occurs not only in pure metals but also in all kinds of alloys and chemical compounds. The discontinuity in the resistance of pure metals lies between 9.2° and 0.3° abs. The supraconductivity depends on temperature and on the exterior magnetic field; there is a relation between specific heat and magnetic field. The theory of the phenomnon has not yet been definitely established. 17 references. Ha (11)

The Penetration of Molten White Metals into Stressed Steels. W. E. GOODRICH. *Iron & Steel Institute,* Advance Copy No. 5, Sept. 1935, 22 pages. Describes results of investigation to determine resistance to interpenetration of various types of steel, subject to stress in the presence of molten white metals, with reference to temperature variations, rate of loading, composition, tensile properties, and microstructure. Premature failure only occurred when samples were stressed in tension in the molten metal. Resistance decreased with rise in temperature and with slower rates of loading. Tests on C, Ni, Ni-Cr, Ni-Cr-Mo, and austenitic steels indicated that static tensile properties were no indication of resistance in molten white metal. Addition of Ni, up to 1.2%, decreased resistance and Mo seemed to have no effect in Ni-Cr steels. Microstructure seemed to be determining factor in resistance. The effect of grain size was very marked, the steels with the finer grains having the greater resistance. Temper brittleness seemed to have no influence on intergranular penetration. JLG (11)

Hardness of Electrolytic Metals (Sur la Dureté des Métaux Électrolytiques). GUICHARD, CLAUSMANN, BILLON & LANTHONY. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 472-473. Includes discussion. Hardness of electrolytically deposited metals is very remarkable and has been attributed in part to the presence of hydrides. Numerous metals such as Ni, Co, Fe, and Cr show no relationship between the hardness of the electrolytic deposit and the H which they occlude. This hardness should be attributed to the structure of the deposit. MAB (11)

Method of Studying Complex Phenomena; Application to Metallurgical Research (Sur une Méthode d'Etude des Phénomènes Complexes; Application à des Recherches Metallurgiques). R. DE FLEURY & H. PORTIER. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 448-453. The author presents a method whereby unknowns in the study of metallurgy may be presented graphically and studied. It involves geometric and analytic interpretation and permits one to use *n* variables. It is particularly applicable to the study of diagrams of alloys of 3 elements. MAB (11)

11a. Non-Ferrous

A. J. PHILLIPS, SECTION EDITOR

Magnesium Alloys (Le Leghe di Magnesio). G. GUZZONI. *Industria Meccanica,* Vol. 13, Aug. 1935, pages 690-696. The development of Mg and Mg alloys is briefly reviewed and the effect of small additions of Ni on their mechanical properties investigated. The tensile strength of Mg is 9 kg./mm.^{2} in cast, and 20 kg./mm.^{2} in rolled state, and is increased by additions of Al and Zn, and only slightly reduced by Cu, Cd, and Pb. The addition of Ni to Mg-Al alloys increases the tensile strength considerably, but the corrosion resistance of Mg alloys with Ni is very bad, much lower than for Mg-Al, Mg-Al-Cd, Mg-Al-Zn. This should be taken into account when a practical use of a Mg-Al-Ni alloy is contemplated. Ha (11a)

Constitution and the Properties of Alloys of Magnesium with Aluminum and Copper (La Constitution et les Propriétés des Alliages de Magnésium avec l'Aluminium et le Cuivre). A. PORTEVIN & P. BASTIEN. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 490-518. Mg-Al-Cu alloys high in Mg are studied. Constitution of system $Mg-Mg_4Al_3-Mg_2Cu$ has been studied by thermal analysis and micrography. The studies indicate a compound $Mg_2Cu_3Al_2$, 2 eutectics, and a solid solution high in Mg. Measurements of hardness, density, and electrical conductivity were used to determine solid solution limits. A detailed study of the mechanical properties has been made of the alloys forged, drawn, and as cast in sand and in permanent molds. The resistance to corrosion of these Mg-Al-Cu alloys was determined by means of the Thyssen-Bourdouxhe apparatus in acid and salt media. Graphs and photomicrographs. MAB (11a)

Magnesium, Aluminum, and Nickel Alloys (Le leghe di magnesio, alluminio e nichelio). G. GUZZONI. *La chimica e l'Industria,* Vol. 17, Apr. 1935, pages 293-300. The influence of additions of Ni to alloys of Mg and Al has been determined. Best results are obtained using 3.5-4.0% Al and 0.5-0.6% Ni. The alloys require a flux, anhydrous MgCl and NaCl mixed in equal proportions giving the best results. Increasing the Ni above 0.5% improves the tensile strength at the expense of castability and ductility. Alloys with over 2% Ni are almost impossible to make due to its limited solubility in the presence of Al, even though Mg and Ni, by themselves, mix in all proportions. The best alloy has the following physical properties:—tensile strength 17-19 kg./mm.^{2}; elongation 8-12%; Brinell hardness 50-55. The best conditions for pouring are to first heat to 850° C., hold for 10-15 min., and then pour when the temperature has dropped to 760°-780° C. Extrusion is carried out as with other light alloys, a temperature of 300°-350° C. being most suitable. The die should be made of W steel, the molds of cast-Fe or mild steel. These alloys do not respond to heat treatment. The alloy containing 7% Al, and 1% Ni is the best for extrusion. It has a tensile strength of 31 kg./mm.^{2}; elongation 14%. Alloys containing Ni, Mg and Al corrode more than those of Mg and Ni alone. The alloys are hard to weld. AWC (11a)

Technology of Aluminum and Its Light Alloys (Technologie des Aluminiums und seiner Leichtlegierungen). A. VON ZEERLEDER. 2nd Edition. Akademische Verlagsgesellschaft, Leipzig, 1935. Cloth, 6½ x 9½ inches, 300 pages. Price 14 RM.

Dr. von Zeerleder is associated with Aluminium Industrie A.G., Neuhausen, and hence is well qualified to write on the technology of aluminum and its light alloys. He has set himself an ambitious task, however, to cover in 300 pages such a broad range of subjects as production of aluminum, aluminum and its alloys and their properties, furnaces and heat treatment, casting of aluminum alloys, rolling and forming methods, welding, soldering, riveting, machining, aluminum bronze powder, surface treatment of aluminum, and general construction methods. Of necessity, the treatment of most of these subjects is rather brief. In general, however, the matter has been well selected and is quite up-to-date. The 204 illustrations used to illustrate this work are most excellent and many of them, new. The principal difference between this edition and the first is an increase of two pages in the length of Table 5 and nine pages added to the bibliography at the end of the book. While naturally based on European practice, the book has not neglected American work. The book is recommended to anyone wanting an up-to-date picture of aluminum technology in the German language. Junius D. Edwards (11a)—B—

A Correlation of Tensile Strength and Electrical Conductivity of Hard-Drawn Copper Wire with Preferred Orientation. R. W. DRIER. *Wire & Wire Products,* Vol. 10, Apr. 1935, pages 137-140; May 1935, pages 183-190; June 1935, pages 230-235, 248. Cold-drawing of Cu is shown to cause a definite type of preferred crystal orientation such that the 111 and the 100 planes which are the planes of easiest slip in face-centered cubic lattices are in a position of strong resistance to deformation. This orientation has an effect on electrical conductivity. The tensile strength does not seem to vary appreciably with the manner of cold-drawing but electric conductivity seems to be higher for wire drawn continuously than for wire with reversal of direction of drawing. Structural micrographs are given. 71 references. Ha (11a)

Alloys of Nickel and Barium. D. W. RANDOLPH. *Transactions Electrochemical Society,* Vol. 66, 1934, pages 85-90; *Metal Industry,* London, Vol. 45, Nov. 16, 1934, pages 467-468. Outline of some of the properties of Ni-Ba alloys, and a description of a new alloy of Ni, Cu and Ba. A method for producing a stable electron emitting surface without the use of the usual oxide coating has been developed which will probably extend the use of these Ba alloys in vacuum tube construction. HBG (11a)

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Variation of the Coefficient of Elasticity During Magnetization of Fe-Ni Alloys (Untersuchung der Variationen des Elastizitätskoeffizienten der Metalllegierung Ni-Fe durch Magnetisierung). Kiyosi Nakamura. *Zeitschrift für Physik,* Vol. 94, May 3, 1935, pages 707-716. Change in Young's modulus, as measured by a magnetostriction oscillator, is small if the Ni content is less than 30% in a series of Fe-Ni alloys but, with higher Ni content, the change in the modulus is greater. FHC (11a)

Free Cutting Aluminum Screw Machine Stock. L. W. Kempf & W. A. Dean. *Metal Progress,* Vol. 28, June 1935, pages 21-27. Describes the development of Al alloy screw machine stock in which the criterion of free machining used was chip size. Variety of alloying elements have been used and several in small amounts seem to produce better results than one in large amount. Physical properties following single (solution) and double (solution and precipitation) treatments of 2 new free machining aluminum alloys are given

	Tensile	Yield	Shear	Elong.	Charpy	Brinell
XA 11 S-W single treat.	46,000	32,000	32,000	24%	17.0 ft-lb	75
double treat.	55,000	35,000	39,000	23	5.0	100
XC 18 S-W single treat.	52,000	31,000	35,000	22	7.3	95
double treat.	60,000	48,000	40,000	14	3.5	135

WLC (11a)

On the Linear Transformation Speed of White Tin into Grey. A. Komar & B. Lasarew. *Physikalische Zeitschrift der Sowjet Union,* Vol. 7, No. 4, 1935, pages 468-473. In English. The linear transformation velocity of white Sn into gray is investigated at temperatures from 18° to 80° C. The measurements are carried out on thin single crystals, a new method of electrolytic infection of white Sn by gray being elaborated. The relation of linear velocity of transformations to supercooling was determined. The velocity values are 200 times greater than those known up to the present time. It is pointed out that the new factors, apart from pressure, must be taken into account to explain the magnitude of the transformation velocity. EF (11a)

Vapor Pressures and Activities of Completely and Incompletely Miscible Metals in Fluid Binary and Ternary Alloys with One and Two Volatile Components (Dampfspannungen und Aktivitäten vollständig und unvollständig mischbarer Metalle in flüssigen binären und ternären Legierungen mit einer und zwei flüchtigen Komponenten). Karl Jellinek & Hans-Andreas Wannow. *Zeitschrift für Elektrochemie,* Vol. 41, June 1935, pages 346-362. The partial vapor pressure of metals over alloys has a practical value and a theoretical value as well while the vapor pressures of the pure metals and the vapor pressures of the low boiling binary amalgams which are most current in the literature have little value. The method for determining the partial vapor pressure involves a method for determining the activity $a_1 = p_1/p_{1,0}$ where a_1 is the activity of component I and $p_{1,0}$ is the vapor pressure of the component I as a pure metal at the same temperature, assuming ideal vapor conditions. The author discusses the determination of activities at high temperatures by measurement of the e.m.f. of a chain and suggests that this method is less accurate than determination of activities from vapor pressure data, due to lack of ideal reversibility of the chain and the setting up of liquid potential differences. An example of this is the Zn, $ZnCl_2$, Zn-Cd chain at 400° C. where the Cd and $ZnCl_2$ may react and contaminate the $ZnCl_2$ with the Cd salt. The apparatus used is described in *Zeitschrift für physikalische Chemie,* Vol. 143, 1929, page 51. With this it is possible to determine the partial pressure of each component of the alloys and salt melts at high temperatures. The results obtained in the investigation are; the heat of vaporization between 785°-1100° C. was determined for Sb, the vapor pressure and activities for completely miscible fluid binary alloys were measured for Sb-Zn at 785° C., Sn-Cd at 700° C., Sn-Zn at 700° C. and at 785° C., the vapor pressures and activities for incompletely miscible binary fluid alloys Pb-Zn were measured at 635° C. and 754° C. inside and outside of the miscibility gap, the extent of the gap could be determined from the vapor pressure measurements, the vapor pressure and activities of molten Zn-Cd alloys were measured at 700° C. both components are volatile and the data of N. W. Taylor were improved by the results obtained by the authors. The activities of the one volatile component Zn in the completely miscible fluid ternary alloy Sn-Sb-Zn were determined at 700° C. The activities of the single volatile component Zn were measured at 653° C. for the incompletely miscible fluid ternary alloy Sn-Pb-Zn. The activities of both volatile components Zn and Cd were determined at 700° C. in the fluid, completely miscible ternary alloy, Sn-Cd-Zn. The data are presented in numerous tables and curves and the text discusses fully the results found, presents calculations for activities from experimental data and describes the conditions of each series of tests. WB (11a)

Effect of Light on the Electric Resistance of Metals (Zur direkten Einwirkung des Lichtes auf den elektrischen Widerstand der Metalle). A. Etzrodt. *Physikalische Zeitschrift,* Vol. 36, June 15, 1935, pages 433-441. The Majorana phenomenon, viz. an increase resistance of Se, Mg, Au (Al) foils due to the effect of light is encountered with Bi, Sn and Ag foils as well as with single crystal wires of Bi. By means of an improved apparatus it is identified as a thermal effect. EF (11a)

Variation of Thermal and Electrical Resistivity in Precipitation Hardening of Al-Cu Alloys (Die Verändlichkeit des Thermischem und Elektrischen Widerstandes bei der Ausscheidungs härtung von Al-Cu-Legierungen). A. Eucken & Hildegard Warrentrup. *Zeitschrift für Elektrochemie,* Vol. 41, June 1935, pages 331-337. Materials tested were 4.0 Cu-.5 Mg, 5.0 Cu-.5 Mg, 7.0 Cu-.5 Mg sheets; 4 and 8% castings and sheet, and 2 grades of pure Al. The Cu-Al alloys were treated at 0° C. and aged at 100° and 215° C. The thermal and electrical conductivity, and the Lorenz number were determined for the material as rolled, heat treated and quenched, and in the aged condition, at temperatures of 0° and —192.2° C. The change in thermal resistivity on heat-treatment and aging runs practically parallel to the electrical resistivity while the Lorenz number remains constant within narrow limits. A hyperbolic function fits the decrease in resistivity with time of aging. For aging at 215° C. the thermal (ω) and electrical (ζ) resistivity lie exactly on the straight line curves of the ω-ζ diagram of Grüneisen & Goens (*Zeitschrift für Physik,* Vol. 44, 1927, page 615). The lower values of the Lorenz number obtained by many investigators for various alloys were obtained with cast alloys but not with rolled plates. The lower values were found to be due to the presence of oxide films on the castings as is shown in comparison micros. The data are presented in tables, curves and discussion of results is given. WB (11a)

Extraction of Gas from Wires Heated in Vacuo (Über den Zeitlichen Verlauf der Gasabgabe Erhitzer Drähte im Vakuum). Gustav Euringer. *Zeitschrift für Physik,* Vol. 96, July 25, 1935, pages 37-52. Experimental results are checked with theoretical computations governing the solubility and the diffusion coefficient of H_2 in Ni. FHC (11a)

Diffusion of H_2 in Pd (Die Diffusions des Wasserstoffs im Palladium). B. Duhm. *Zeitschrift für Physik,* Vol. 94, Apr. 8, 1935, pages 434-456. Electrical resistance measurements were made to determine the coefficient of diffusion of H_2 in Pd and found to be equal to 9.6×10^{-5} $cm.^2$/sec. when the concentration of H_2 varied from 0 to 30 times the volume of the metal and again when it varied 800 to 1000 times the volume of the metal. FHC (11a)

The Thermionic Properties of Tantalum. Alvin B. Cardwell. *Physical Review,* Vol. 47, Apr. 15, 1935, pages 628-630. Ta was carefully outgassed and its photoelectric and thermionic properties simultaneously studied. Heating 1000 hrs. at temperatures up to 2200° K produced an apparent stable condition of the surface. Further heat treatment at temperatures up to 2500° K produced a final stable condition. A comparison of the results with the previously published photoelectric data shows that the value of the photoelectric work function determined according to Fowler's method agrees with the value of the thermionic work function of the same surface regardless of whether the surface is thoroughly outgassed. WAT (11a)

Copper Data. Published by the Copper Development Association, London, 1935. Board covers, 4 x 6⅝ inches, 66 pages.

This book is the latest addition to the Engineers' Note-Book Series of the Association. In it there has been collected all the generalized information on copper which the ordinary user is likely to need. Richard Rimbach (11a)-B-

Tungum Alloy. *Engineer,* Vol. 160, July 12, 1935, page 44; *Engineering,* Vol. 140, July 5, 1935, page 9. This alloy which is highly corrosion resistant contains Cu 81-84%, Al 0.75-1.20%, Ni 0.85-1.40%, Si 0.80-1.30% and Zn the remainder. Tests were made with samples of 2" ropes of the alloy, half of the specimens were kept indoors and half were suspended in sea water just below the high-water mark for a period of 27 mo. A slight film of verdigris appeared on the exposed specimens while those kept indoors did not change in appearance. After 6 mo. tensile tests were made on single wires of 0.043" diameter. The tensile strength of 3 indoor specimens was 66.7, 67.3 and 67.3 $tons/in.^2$, respectively. Elongation of all 3 specimens was 2% in 2". Tensile strength of exposed specimens was 62.4, 66.4 and 64.6 $tons/in.^2$ Elongation of these was 0.5, 2.0 and 0.5%. From alternating-bending corrosion-fatigue tests it was assumed that for 10 million repetitions of stress, the safe fatigue range in air could be ± 15 $tons/in.^2$ and in sea water ± 10.5 $tons/in.^2$ In the rolled-soft condition the Izod value is 65 ft.-lb. and in the forged-soft condition, 74 ft.-lb. LFM (11a)

Certified Amalgam Alloys: A.D.A. Specification No. 1. Executive Board, Research Commission A.D.A. *Journal American Dental Association,* Vol. 22, June 1935, pages 1028-1029. Reports the 4th survey of amalgam alloys (May 4, 1935). Only the alloys meeting the specifications of A.D.A. No. 1 are listed, but these include 31 brands made by 23 manufacturers. OEH (11a)

■ 11b. Ferrous ■

V. V. KENDALL, SECTION EDITOR

Bethlehem Alloy Steels. Bethlehem Steel Company, Bethlehem, Pa., 1935. Paper, 6½ x 9 inches, 375 pages. Price $1.00.

While this is classed on the title page as "Catalog 107," it is really a handbook, giving physical property charts of practically all the usual alloy and special steels, and briefly discussing the types of steel suitable for varied uses.

The section on testing and properties concisely discusses, among various other items, grain size, with charts, the "P-F" test, hot acid etching, effect of mass. Another section deals with quenching media, precautions in heating steel and the like. One hundred forty (140) pages of tables follow.

The book is both beautifully and durably printed and bound. It is not intended for general sale, but only for customers and prospective customers and those actively engaged in the industry. The nominal price charged is undoubtedly far below the actual cost of the book-making alone. The references to Bethlehem are so incidental and the advertising angle so restrained that the reader will consider it as a handbook and keep it handy for use. This looks like good psychology. Anyhow, we are not going to put our own review copy in the library, but in our own office bookcase, and when we refer to it and the Bethlehem name catches our eye as we leaf over the pages our mental reaction will be one of appreciation to Bethlehem for preparing a convenient and useful handbook in which the most important data on alloy steels are all brought together.

The illustrations are attractive, one of the most interesting being a photo of the Taylor-White experimental laboratory in 1899. H. W. Gillett (11b) -B-

Molybdenum Steels—Their Manufacture and Application. J. L. F. Vogel & W. F. Rowden. High Speed Steel Alloys Ltd., Widnes, England, 1935. Paper, 7½ x 10¾ inches, 103 pages. Price 5s.

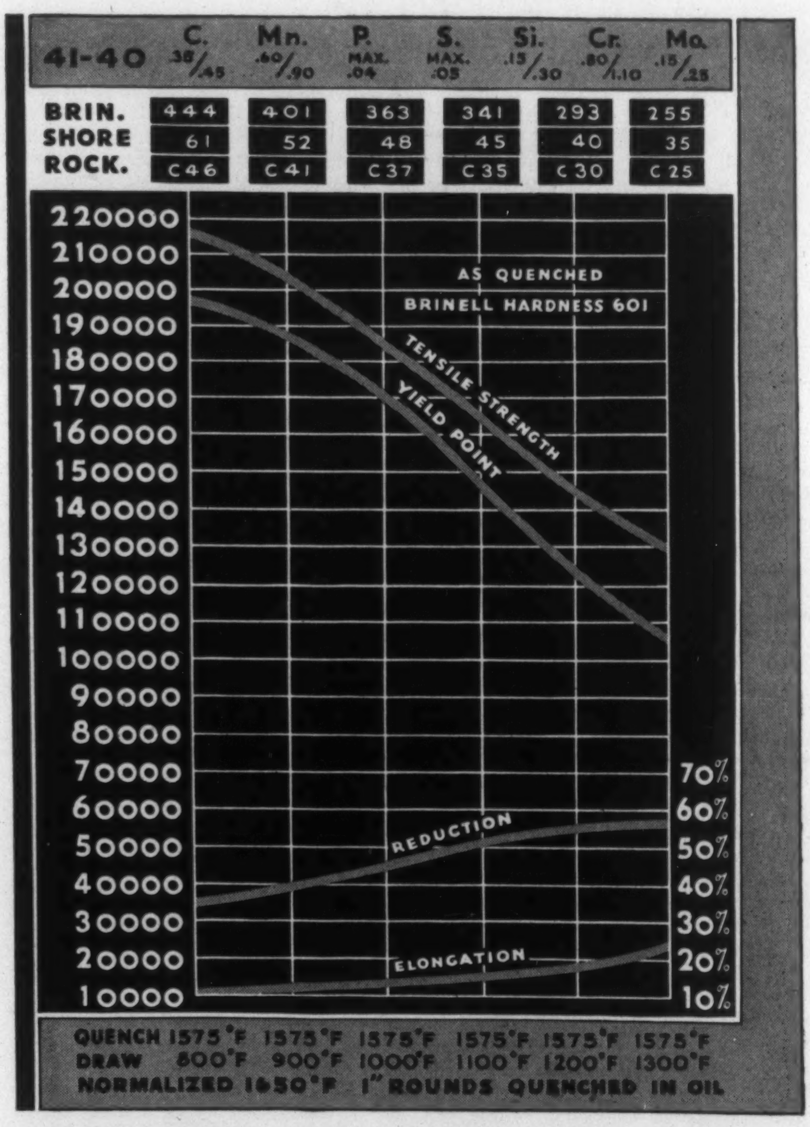
This is an advertising booklet in that it is published by a maker of ferro-alloys, but it is not mere propaganda, as all the benefits conferred by Mo are brought out by definite test results, almost without exception from British sources, and on commercial production.

The foreword, by Lord Riverdale of Sheffield, states "the information contained in this book is probably known to most steel makers and consumers," and indeed we fail to find any information on Mo steel not previously available. Molybdenum high speed steel is not played up as much as recent American experience would indicate it to deserve, it is only mentioned as "in the course of development" and dismissed with half a page.

An interesting point is the listing of rotary pulverized fuel furnaces among the equipment used for production of steel castings. An illustration is given of a battery of four, though is it not stated that these are all in use on steel. H. W. Gillett (11b) -B-

SOME NOTES ON BETHLEHEM ALLOY STEELS

V-Molybdenum Steels



★ *Physical properties of S. A. E. 41-40, a chrome-molybdenum steel producing good combinations of properties* ★

Molybdenum imparts definite benefits to steel when subjected to heat treatment. A relatively small percentage of molybdenum exerts a profound influence in increasing the desirable properties of other alloying elements, such as manganese, nickel, and chromium, and also nickel with chromium. Molybdenum as an alloy also tends to counteract temper brittleness.

Steels containing molybdenum are classified under the S. A. E. 4xxx Series. The 41xx Series contains chromium, as well as molybdenum; the 43xx Series, both nickel and chromium. The 46xx Series contains 1.65 to 2.00 per cent nickel and the 48xx Series has a nickel content of from 3.25 to 3.75 per cent. Among all these S. A. E. Steels the molybdenum content varies from 0.15 to 0.40 per cent in 10-point ranges.

Straight molybdenum steels, which do not find as wide an application as do the steels in which molybdenum is combined with other alloys, are furnished chiefly for special uses, with carbon content varying from 0.20 to 1.00 per cent.

The 41xx chrome-molybdenum Series has a large field of usefulness, and is produced with carbon content varying from 0.25 to 0.55 per cent. This series is further divided into two general classifications: those having from 0.50 to 0.80 per cent chromium, and those containing from 0.80 to 1.10 per cent chromium. With a carbon content of from 0.25 to 0.35 per cent, the 41xx Steels are of the water-hardening type, and are used for airplane tubing, bolts, studs, axles, intake valve parts, spindles, shafts, connecting rods and similar applications. With a carbon content above 0.35 per cent, they become oil-hardening, and are used for such parts as heavy-duty gears, shafts, bolts, studs, airplane cylinders, piston rods and studs. The 41xx Series is also finding some application in high-temperature service.

The 46xx Steels, containing from 1.50 to 2.00 per cent nickel with molybdenum, are usually lower-carbon steels. They are used for carburized parts in which hard surface and high ductility in the core are demanded. 46xx Series finds its largest applications for gears of various types in the automotive field, for journals, spline shafts, king pins, pinions, roller bearings, bolts, studs, set screws, collets. The 48xx Series of molybdenum steels is similar to the 46xx carburizing steels, except for the higher nickel content. The 4640 Steel is rapidly becoming popular as an oil-hardening grade.

The combination of nickel and chromium with molybdenum in the 43xx Series produces a steel having a combination of good ductility and resistance to shock with very high strength. Although it cannot now be classed as a popular grade, it fills a very important position where a special-purpose steel is required.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

Molybdenum in Steel, Cast Iron and Alloys (Aciers, Fontes et Alliages au Molybdene). *Usine,* Vol. 44, July 18, 1935, page 30. The advantages of adding Mo for improving mechanical properties and facilitating heat treatment are briefly described. Steel with low Cr content must have at least 0.30% Mo; a good wear-resistant material is composed of C 0.7%, Ni 0.6-0.8%, Cr 1.4-1.6%, Mn 0.8-1.0%, Si 0.2-0.4%, Mo 0.3-0.4%. It is heated uniformly to 980° C., cooled in the furnace, worked (machined), heated to 900° C., cooled in air, drawn between 325° and 675° and cooled in air. Brinell hardness varies between 300 and 500. A steel for saws is recommended with 0.6% C, 3.5% Cr, 6.75% Mo, 1% W; it can easily be forged at 1100° C., tempering at 800-875° renders the material softer. The Mo content in cast Fe should not be below 0.35%, resistance to fracture and bending is improved about 40%, Brinell hardness about 25%, without impairing machinability; denser castings of thicker walls can be produced with Mo. Ha (11b)

A Study of the Elastic Properties of Certain Specimens of Mild Steel. J. E. Hurst. *Metallurgia,* Vol. 12, July 1935, pages 85-86. Rings were cut from cold-drawn tubes and internal stresses were measured by cutting these rings and measuring the movement at the gap both before and after heat treatment. Elastic properties of the rings were also studied. JLG (11b)

Influence of the Degree of Forging and Size of Heat Treated Section on the Mechanical Properties of Structural Steels (Einfluss des Verschmiedungsgrades und des Vergütungsquerschnittes auf die Festigkeitseigenschaften von Baustählen). H. Korschan & E. Maurer. *Stahl und Eisen,* Vol. 55, Aug. 1, 1935, pages 828-830. C, Mn, Ni and Cr-Ni-Mo structural steels were studied. These were reduced by forging 65-fold and 5-fold respectively, the 65-fold reduced bars to 40 mm. sq. size and the 5-fold reduced billets to 920 mm. diam. size. Both sizes were then oil quenched and drawn to the same tensile strength. In longitudinal tests the 40 mm. sq. bars had about 40% higher yield point, 37% higher reduction of area, and 128% higher impact resistance than the 920 mm. diam. billets. However, when 40 mm. sq. bars were machined out of the 920 mm. billets and heat treated to the same tensile strength, these 40 mm. bars reduced in forging only 5-fold gave the same mechanical properties as the 40 mm. bars reduced in forging 65-fold. This indicated that the better properties of the smaller bars was due more to the greater efficacy of the heat treatment on smaller sections than to greater reduction in forging. SE (11b)

Cause of the Incompatibility Occasionally Found Between Elongation and Tensile Strength of Malleable Iron Test Bars. Enrique Touceda. *Transactions American's Foundrymen's Association,* Vol. 6, Apr. 1935, pages 407-415. The subject of the incompatibility between tensile strength and elongation which is occasionally found in malleable iron test bars was investigated using over 7000 bars. This incompatibility was always accompanied by a very small, characteristic surface defect in the rim of the fracture. No other defect was found that would account for the abnormally low elongation, and bars which were chemically or structurally defective were affected in all the tensile values. It is the opinion of the author that this defect is caused by a layer of very fine dirt from the sea coal facing. Neither the trade nor the malleable industry need feel the slightest concern about this incompatibility. CEJ (11b)

Mechanical Properties of the Low Chromium-Medium Carbon Steel. Yasusuke Takeuchi. *Denki-Seiko (Electric Steels),* Vol. 11, June 15, 1935, pages 277-302. In Japanese. Using specimens prepared from 3 low Cr-medium C steel ingots (1.82-2.00% Cr, 0.44-0.5% C) transformation points, Ac_1, Ac_3, Ar_3 and Ar_1, were determined to be 725°-730°, 755°-760°, 700°-705° and 665°-670°, respectively. 514 specimens thus prepared were subjected to mechanical tests after various heat treatments. The values of each mechanical property obtained from the tests were assorted into several ranges according to their amount. The range of values in which the largest number of specimens belonged was taken as standard, and the following results were obtained.

	Brinell hardness	
Condition	Standard ranges	% of number of specimens in these ranges
forged	200-240	90
annealed at 750°	180-200	95
quenched in oil at 850°	515-555	74

	Standard ranges				
Tempering* temp. (C)	Tensile strength (kg./mm.²)	Elongation (%)	Reduction of area (%)	Impact values (kg.m/cm²)	Brinell hardness
620°	88-106	20-24	55-65	11-19	302-255
650°	86-102	20-24	59-66	12-18	285-248
700°	76- 88	25-29	60-68	16-20	255-217

* Tempering after quenching in oil at 850°.

Ratios of Brinell hardness (H) and tensile strength (R), and those of yield point (E) and tensile strength (R) were calculated as follows:

Tempering temp. (C)	620°	650°	700°
H/R	2.85	2.78	2.87
E/R	0.885	0.870	0.890

TS (11b)

The Strength and Flexibility of Corrugated and Creased-Bend Piping. Robert L. Dennison. *Journal American Society of Naval Engineers,* Vol. 47, Aug. 1935, pages 343-438. Corrugated and creased-bend piping may be installed with smaller radius bends than corresponding smooth-walled piping thus explaining its preferred use in cramped quarters. The piping was tested for tensile properties and endurance in fatigue. Huge rotating beam specimens were tested as were L and U bends. Photographs of the test outfit are shown. The conclusions are that corrugated arc compared to smooth pipe of same major dimensions had a relative flexibility advantage of 2.6 to 1, creased-bend piping 1.3 to 1. Flexibility of both pipes (nominal wall thickness of about .288″) appeared to be unaffected by internal hydrostatic pressure of 400 lbs./in.² Stress intensification factors at the endurance limits of the pipes are: Series A,N 8.7, Series B,N 9.5, Series C,N 6.1. All fatigue cracks on the corrugated and creased-bend piping with only one exception occurred by starting from the inside therefore failure cannot be anticipated from appearance of the outside surface of the piping. Stress intensification factors for cycle values below endurance limit are tabulated. WB (11b)

Non-Magnetic Cast Iron. *Journal of Commerce, Shipbuilding & Engineering Edition,* Aug. 1, 1935, page 2. Brief description of the properties of a Ni-Mn austenitic cast Fe with non-magnetic properties. The maximum magnetic permeability is 1.03, the specific resistance 150 micro-ohms/cm.³, and the resistance temperature coefficient 0.00045 between 0° C. and 100° C./1° C. The metal has a good tensile strength, is soft and easily machinable, and is particularly suitable for electrical castings on account of its low electrical and magnetic losses. JWD (11b)

Non-Magnetic Cast Iron in the Electrical Industry. *Foundry Trade Journal,* Vol. 53, Aug. 1, 1935, page 78. Abstracted from *The Nickel Bulletin.* Perhaps the best known of the non-magnetic cast irons is the high-Ni Ni-Mn austenitic cast iron known as *Nomag* developed 15 years ago by S. E. Dawson and Messrs. Ferranti. "Nomag" has a magnetic permeability as low as 1.03. It is soft and easily machinable. Its tensile strength is similar to that of ordinary gray iron, but it is distinctly tougher and more resistant to shock. AIK (11b)

The Properties of Some Low-nickel Steels Containing Manganese. R. H. Greaves. *Iron & Steel Institute,* Advance Copy No. 6, Sept. 1935, 15 pages. Mechanical properties of steels containing 0.3 to 0.4% C, 0.7 to 1.35% Mn, and 0.5 to 2.0% Ni were determined. When normalized, a steel with 0.35% C, 1% Mn, and 1 to 1.5% Ni has better mechanical properties than a 3% Ni steel, a 1.4% Mn steel, or a Si-Mn steel of the high-elastic-limit type. Steels of this composition do not harden fully when quenched in oil in sections ¾″ thick and are subject to mass effect, but their properties in the oil-quenched and tempered condition are equal to those of 3 to 4% Ni steels with lower Mn. The high-Mn low-Ni steels are recommended as substitute for the higher Ni steels for sections under 2½″. 6 references. JLG (11b)

The Development and Use of Low Alloy High Tensile Steels. A. E. Gibson. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 2-8. These steels are said to represent the greatest dollar value for high physical value and low weight in the steel industry. The use of Cu in amounts greater than the .3% which in the past has been considered to improve corrosion resistance is discussed with particular attention paid to the 2% Ni-1% Cu steels which have a 50% greater yield value than the same analysis without the Cu. Results are tabulated for the 2% Ni-1% Cu steel in welded condition and after various heat treatments for the low C (.08) and higher C (.22) and comparison made on the basis of physical properties with a straight 2% Ni steel with .10 C. Another table is given for physical properties of Cromansil, Man-ten, Cor-ten, Cu-Mo, and Cu-Ni-Mo steels as rolled and as welded. Typical micros of the 2% Ni, 1% Cu steels are given for various heat treatments also micros of Cu-Ni-Mo steel for parent, heat affected and welded zones. The max. yield and tensile values are obtained in the 2% Ni, 1% Cu steels by heat treatment at 900° F. which gives precipitation hardening and material of low impact value. The article stresses the fact that material in such condition cannot be used for structures subject to shock. The best Charpy impact with good tensile and elongation is obtained for this material by normalizing between 1450° to 1600° F. WB (11b)

An Investigation of Spring Steels. J. H. Andrew & G. T. Richardson. *Iron & Steel Industry,* Vol. 8, Aug. 1935, pages 440-443. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 335L/8. CEJ (11b)

Effect of the Accompanying and Additional Elements Silicon, Phosphorus, Nickel, Chromium, Molybdenum, Tungsten and Copper on the Wall Sensitiveness of Gray Iron (Einfluss der Begleit- und Zusatzelemente Silizium, Phosphor, Nickel, Chrom, Molybdän, Wolfram und Kupfer auf die Wandstärkenempfindlichkeit von Grauguss). E. Hugo, E. Piwowarsky & H. Nipper. *Giesserei,* Vol. 22, Aug. 30, 1935, pages 421-428; Sept. 13, 1935, pages 452-458. New experiments are discussed which were made to determine the effect of Si, P, Ni, Cr, Mo, W and Cu with increasing wall thickness of a box-shaped gray Fe specimen upon tensile, bending and shearing strength, hardness and carbide content. The results corroborated the previously found unfavorable effect of Si and P and the favorable effect of Ni particularly if the latter partly replaces Si, in presence of Cr. If Ni is absent the Si content, to compensate for the hardening effect of Cr, must not be too high. Mo acts similarly to Ni but does not compensate for hardness as well as Ni. W and Cu have a favorable but less pronounced and even a neutral action on the influence of wall thickness. A new method was developed to test shearing strength; the effect of the elements on shearing strength was similar as found and described before for other properties. Tables and curves show the numerical values and relations developed from the results. 37 references. Ha (11b)

The New, Low Carbon Alloys, Their Past, Present and Future. J. C. Hodge. *Industry & Welding Quarterly,* second quarter 1935, pages 44-47, 72. Use and compositions of high strength structural alloy steels are reviewed. Ha (11b)

Heat Treatment of Magnetic Materials in a Magnetic Field. Part I. Survey of Iron-Cobalt-Nickel Alloys. Part II. Experiments with Two Alloys. J. F. Dillinger & Richard M. Bozarth. *Physics,* Vol. 6, Sept. 1935, pages 279-284, 285-291. Annealing Fe-Co-Ni alloys in magnetic field increases max. permeability, hysteresis loss and coercivity. Increases of max. permeability are of the order of 5000 to a high of 300,000 and others from 20,000 to 600,000, the latter being obtained with a special anneal of 18 hours at 1400° C. on 65 permalloy. The effect is more readily obtained with a thorough, preliminary anneal, the more usual anneal for the tests being 1 hour at 1000° C. and furnace cooled at the rate of 300° C./hr. The samples were then wound with Cu wire for magnetizing and annealed at 50° above Curie point in an atmosphere of H_2; the magnetizing field was maintained while cooling in furnace. All of the alloys with Curie points above 500° C. and no phase transformation are affected as to permeability, etc. Material annealed in magnetic field has $H_{max.}$ less affected by stress (tension) than material annealed without field. Magnetic properties of magnetic field annealed material are anisotropic and may be 150 times greater in one direction than another, highest $H_{max.}$ values are obtained by measuring parallel (circular) to the field applied during the anneal. Authors conclude that magnetostriction produces plastic deformation with high Curie point material and a preferred magnetic orientation. Part II reports results obtained for permalloy with 65% Ni, 35% Fe (65 permalloy) and perminvar 20% Fe, 60% Co, 20% Ni with respect to changes cited in part 1. Domain theory of ferromagnetism is used to explain observed effects and indications are that strains due to magnetostriction when external field is applied and to cooling of material through Curie point are relieved by plastic flow or diffusion in the separate domains. WB (11b)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Methods of Testing Thermocouples and Thermocouple Materials. William F. Roeser & H. T. Wensel. *Bureau of Standards Journal of Research,* Vol. 14, Mar. 1935, pages 247-279. Describes various methods used for testing thermocouples and thermocouple materials, and the precautions which must be used in order to attain various degrees of accuracy. In particular, it describes in detail the methods developed and used at the Bureau of Standards. It also provides some guidance to the reader in the selection of the method which is best adapted to a given set of conditions. WAT (12)

Standard Tables for Chromel-Alumel Thermocouples. William F. Roeser, A. I. Dahl & G. J. Gowens. *Bureau of Standards Journal of Research,* Vol. 14, Mar. 1935, pages 239-246. Tables have been prepared giving the thermal e.m.f. of chromel P vs alumel, chromel P vs Pt, and alumel vs Pt at various temperatures in the range —310° to 2500° F. The values in the range 0° to 2500° F. are based on the calibration of 15 representative No. 8 gage chromel-alumel thermocouples selected after preliminary tests on 50 heats of each alloy made by the method regularly used. The tables give the temperature-e.m.f. relation of the thermocouples now being manufactured as closely as the wires can be reproduced at the present time. The guarantee limits have been fixed by the manufacturer at ± 5° F. in the range 0° to 660° F. and to ± ¾% in the range 660° to 2300° F. The methods used in the calibration of the thermocouples in the various temperature ranges are briefly described. WAT (12)

An Effect of Oxygen and Sulphur in Scaling. J. H. Whiteley. *Engineer,* Vol. 159, May 10, 1935, page 484; *Engineering,* Vol. 139, May 17, 1935, page 525; June 28, 1935, pages 691-694; *Heat Treating & Forging,* Vol. 21, May 1935, pages 223-228; June 1935, pages 275-279. From a paper read before the Iron & Steel Institute, May 1935. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 374L/6. LFM + MS (12)

Developing Alloy Steels for High-pressure Boilers and Pressure Vessels. L. P. McAllister. *Steel,* Vol. 97, Aug. 5, 1935, pages 30-33, 48. **Modern Materials for High Pressure Boilers.** *Railway Mechanical Engineer,* Vol. 109, Sept. 1935, pages 387-388, 391. Paper presented before the National Board of Boiler and Pressure Vessel Inspectors, May 1935. See "Modern Materials for High-pressure Vessels," *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 374L/8. Ha + MS (12)

Investigation of the Behaviour of Metals Under Deformation at High Temperatures. Part I.—Structural Changes in Mild Steel and Commercial Irons During Creep. C. H. M. Jenkins & G. A. Mellor. *Iron & Steel Institute,* Advance Copy No. 11, Sept. 1935, 49 pages. Describes results of study of effects of deformation at high temperatures of several varieties of Fe and mild steel and shows marked differences in behavior which are probably related to the mode of manufacture. The study was made by microscopical examination of material subject to creep (at high loads for creep testing) and short-time tensile tests at high temperatures. The test pieces were kept free from attack by air by stressing in a vacuum in specially built units. The nature of the creep movement was studied in relation to structural changes observed both on the surface of the polished test piece and on internal sections. Results showed that slip, grain-boundary movement, and recrystallization are prominent features in the mode of deformation at higher temperatures. Spheroidization is also important in mild steels below the critical range. Intercrystalline cracking was encountered in specimens of Armco iron. Recrystallization in creep tests proceeds by a continuous action accompanying deformation and is most prominent in places of maximum deformation. 15 references. JLG (12)

Creep Tests According to Rohn's Method (Dauerstandversuche nach dem Verfahren von W. Rohn). R. Scherer & H. Geipel. *Archiv für das Eisenhüttenwesen,* Vol. 9, Aug. 1935, pages 99-102. Rohn's method of determining the creep strength consists of putting the specimens under a certain load at an elevated temperature; as the specimen elongates or creeps beyond a certain amount it automatically shuts off the furnace; in this way the temperature fluctuates until it reaches a constant value. The load then gives the creep strength for that temperature. For an appreciable elongation to take place the sample should be quite long, as long as 300 or even 450 mm., and it is difficult to keep the temperature constant over this length. The original temperature chosen must be near the equilibrium temperature, otherwise undue fluctuations will occur. There appeared to be no correlation between the Rohn creep strength and the so-called short-time creep strength for an elongation of 0.0005%/hr. between the 25th and 35th hour at a certain temperature, so that the Rohn method does not confirm the merit of this test, nor is it of itself a short time test. However, for longer time creep tests of 1,000 to 10,000 hrs, the ordinary creep test for constant load and temperature and the Rohn test for constant load and fluctuating temperature (until an equilibrium is reached) give similar values. In this case the Rohn method may have the advantage of requiring fewer specimens. SE (12)

Influence of Prolonged Exposure in Steam at 450° on the Mechanical Characteristics of Various Steels and Alloys (Influence d'une Exposition Prolongée dans la Vapeur à 450° sur les Caractéristiques Mécaniques de divers Aciers et Alliages). M. Sauvageot. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 519-530. Variation of mechanical properties of non-cold-worked and of cold-worked bars of various steels and alloys exposed for 1-3 years in steam separators is studied. In certain steels maintained at 450° there occurred a hardening action very distinct from structural hardening, and quite apart from the expected diminution of ductility for steels subject to blue brittleness and the softening by partial disappearances (annealing action) of the effects of cold working. This hardening effect is greatest at 3 years, after which time it declines. Certain steels were particularly adaptable for use at 450° C. and for the construction of high pressure boilers. The compositions of such steels included Mn, Cu, Cr, Ni and Mo. MAB (12)

Design and Selection of Heat Enduring Alloys for Industrial Furnaces. R. Stuart Brown. *Industrial Heating,* Vol. 2, Sept. 1935, pages 495-498, 514. Principal requirements for such alloys are oxidation resistance so that they last indefinitely at the operating temperature; structural stability, in particular permanent ductility under heat; corrosion resistance against S for use with some fuels; and high temperature creep strength. Oxidation and corrosion resistance are largely determined by Cr and Ni content, structural stability and creep strength depend almost entirely on the minor elements in the composition and on the methods employed for melting and casting. Correct design and use of practical data are discussed. Ha (12)

Use of Metals in the Manufacture of Heat Recuperators (Note sur l'Emploi des Métaux dans la Construction des Récuperateurs). Choisy. *Chaleur et Industrie,* Vol. 16, Aug. 1935, pages 379-381. Metal, which has been previously judged unsuitable, is to be considered again in this industry because heat resisting steels of high quality can now be made. FR (12)

Mechanical Properties of Metals at Elevated Temperatures (Étude mécaniques des métaux aux temperatures élevées). Pierre Chevenard. *Métaux,* Vol. 10, Mar. 1935, pages 76-86. In the laboratories of the Steelworks at Imphy, France, the following apparatus for determining the mechanical properties of metals at high temperatures are used: Torsion oscillometer which consists of a Coulomb pendulum with the suspending wire heated electrically to a uniform and constant temperature; the period of oscillation is measured for each difference in temperature. Relaxometer, measuring the relaxation from the initial tension, the length of the sample remaining constant during the test. A machine for testing under loads at constant temperatures. GTM (12)

The Effect of Molten Solder on Some Stressed Materials. G. Wesley Austin. *Journal Institute of Metals,* Vol. 58, Oct. 1935, pages 473-487 (Advance Copy No. 717). Materials tested comprised 6 metals, 10 non-ferrous alloys and 16 steels. Tensile tests were made in oil and in solder at temperatures up to 600° F. Almost all of the metals and alloys used in engineering if stressed in tension and in contact with molten solder are susceptible to penetration and weakening to a greater or lesser degree. Ni, Monel, and cupro-Ni are, however, but slightly affected. The plain low-C steels and the low-C pearlitic and austenitic heat- and rust-resisting steels do not appear to be as subject to penetration as similar steels with high C. Increased grain size increases liability of penetration. Neither the temper-brittle nor the burnt state appears to increase susceptibility to penetration by solder. Stress-strain curves indicated that the penetration of solder caused an interruption of the normal curve and that the shape of the curve remained unaltered. 6 references. JLG (12)

Mechanical Properties at High and at Low Temperatures, of Metals Subjected to Corrosion (Propriétés mécaniques à froid et à chaud des métaux soumis à la corrosion). J. Galibourg. *Aciers Spéciaux, Métaux et Alliages,* Vol. 9, Oct. 1934, pages 354-363. Corrosion has a two-fold effect on the mechanical properties of a metal: first, it reduces the section and therefore gradually increases the stresses; second, corrosion depends on temperature and the properties change especially at elevated temperatures, depending on the time t, load P, length L and temperature θ. These factors are related by the formula: $dL/L = dP/\mu + \alpha d\theta + Vdt$, where μ is the modulus of elasticity under tensile stress, α expansion coefficient, and V the velocity of increase in length due to viscous flow. Testing methods to determine the various factors by keeping one or more constant are reviewed, and results obtained by other workers in this field are compared and illustrated by curves. As a practical consequence of the discussion it is held that a metal need not necessarily have to resist corrosion and all its attendant effects indefinitely. It is sufficient if excessive deformation or fracture of a material under continuous action of temperature, corrosion and load, does not occur before either the design has become obsolete or the piece has been written off. Better knowledge of the resistance of materials at elevated temperatures, and the development of materials having still better behavior are considered important problems for the future. GTM + Ha (12)

Alloy Steels for Boiler Drums and Superheaters. G. K. Herzog. *Blast Furnace & Steel Plant,* Vol. 23, Aug. 1935, pages 554-556, 574; Sept. 1935, pages 630-632. Paper read before the National Board of Boiler and Pressure Vessel Inspectors. Discusses steels suitable for high-temperature, high-pressure steam equipment. Elements found most useful for imparting the desired creep strength, tensile and fatigue properties, impact strength, and resistance to corrosion and oxidation are Cr, Mo, W, V, Mn, Si, and Ni. Effects of each of these are outlined briefly. Indicates properties of 18% Cr-8% Ni; 12-16% Cr and 2.5-3% W; 4-6% Cr and 1% W or 0.5% Mo; 0.15% C, 1-1.5% Cr, 0.5% Mo, and 1% Si; 0.1-0.2% C and 0.45-0.65% Mo; 1.25% Mn-0.25% Mo; Cr-Al; and 0.4-0.6% Cr, 1.1-1.4% Mn, and 0.6-0.9% Si steels. Most satisfactory steels for bolts for high-temperature, high-pressure service contain 0.5-1.5% Cr and 0.2-0.6% Mo. MS (12)

Mechanical Properties of Steels at High Temperatures in the Presence of Corrosive Gases (Résistance Mécanique à Chaude des Aciers en Présence de Gaz Corrosifs). I. Musatti & A. Reggiori. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 557-571. Includes discussion. The work includes studies of creep and corrosion resistance at temperatures of 500°-800° C. of 2 steels, one containing 18% Cr and 8% Ni and the other 13% Cr and 0.4% Mo. The tests were made in a sulphurous anhydride atmosphere and in normal atmosphere. The first caused the 18-8 steel to disintegrate at about 650°. Corrosion occurred between the crystals and caused intercrystalline cracks without deformation. The corrosive action of the S was superficial and hardly affected the resistance to creep. The steel with 13% Cr and 0.4% Mo was much less affected by the corrosive action of the anhydride, even under mechanical stress. Bibliography. MAB (12)

13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

Theory of Passivity Phenomena. XXVII. On Time-Phenomena During Anodic Polarization of Smooth Platinum in 2 Normal Sulphuric Acid (Zur Theorie der Passivitätserscheinungen. XXVII. Über Zeiterscheinungen bei anodischer Polarisation am glatten Platin in 2n Schwefelsäure). Wolf Johannes Müller & O. Hering. *Sitzungsberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse, Abt. II B, Chemie,* Vol. 144, No. 5, 1935, pages 167-198. The course of anodic polarisation of bright Pt in 2N H_2SO_4 was determined with a testing arrangement permitting the recording of both current-time and potential-time curves. Effective potentials ranging from 1.8 to 3.5 volts were investigated, a Pt screen serving as cathode. The ratio of initial (after 0.005 sec.) to final (after 20 min.) current intensities varies considerably. The ratio is 1 : 150 and 1 : 1.5 respectively for an effective potential of 1.8 and 3 volts. The amount of current passing during electrolysis after the first pronounced drop of current is practically independent of the effective potential (mean value = 18 x 10^{-4} coulomb). There are 2 reactions during the anodic polarization of Pt. The higher the effective potential the earlier the O_2 liberation. Under these testing conditions, the first current drop corresponds to the solution of Pt in the pores up to an anodic potential of 2 volts. Only if the protective film potential in the pores exceeds 2 volts, O_2 liberation starts. The latter reaction is accompanied by a current decrease which however is relatively small in comparison with the current drop due to the clogging up of the pores. WH (13)

Interrelation between Corrosion and Static Tensile Stress in Structural Steels (Zur Frage der Wechselwirkung zwischen Korrosion und statischer Zugbeanspruchung bei Baustählen). E. W. Müller. *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke Aktiengesellschaft Dortmund,* Vol. 4, Dec. 1934, pages 207-234. The mutual effect of corrosion and mechanical stress was investigated on pure Fe and alloyed steels, with and without Cu content, in air and in flowing city water. The specimens not under stress showed in general greater rusting in air than those under stress, the layer of rust seems to adhere more firmly on the bars not under stress. The attack in water was less on the specimens without stress. The attack by rust on bars deformed by permanent stress was higher than on bars under elastic stress only. Previously artificially aged specimens corroded the more with increasing tensile stress. The manufacturing process apparently had no influence. The effect of tensile stress on the electrochemical behavior of Fe was also investigated but no conclusive results could be established, except that a wire in an electrolyte and stressed beyond the elastic limit became baser in its potential with increasing deformation. The scaling at different temperatures (up to 700° C.) was also somewhat affected by tensile stress. 24 references. Ha (13)

The Corrosion of Wrought Iron and Steel. R. Morgan, P. D. Dalsimer & N. Smith. *Engineering,* Vol. 139, Mar. 1, 1935, page 233. Brief abstract of article published in *Journal of the Franklin Institute.* See *Metals & Alloys,* Vol. 6, July 1935, page MA 301L/4. VSP (13)

Atmospheric Exposure Tests on Nonferrous Screen Wire Cloth. G. Willard Quick. *Bureau of Standards, Journal of Research,* Vol. 14, June 1935, pages 775-793. Atmospheric exposure tests on 7 compositions of nonferrous screen wire cloth were made at the Bureau of Standards in cooperation with the American Society for Testing Materials over a period of about 9 years. The specimens were exposed at Pittsburgh, Pa., a heavy industrial atmosphere; at Portsmouth, Va., and Cristobal, C. Z., a temperate and a tropical seacoast atmosphere, respectively, with some industrial contamination; and at Washington, D. C., a normal inland atmosphere. At the termination of the tests at least one failure had occurred in each of the materials exposed at Pittsburgh; one of the materials had failed at both Portsmouth and Cristobal; while at Washington none of the materials had failed. The tensile strengths of the materials before and after exposure are compared. There was no consistent relation between the results of laboratory accelerated-corrosion tests and the atmospheric-exposure tests at any of the locations. The type chemical composition of the materials tested were, (1) 90% Cu, 10% Zn; (2) 80% Cu, 20% Zn; (3) 75% Cu, 20% Ni, 5% Zn; (4) 70% Ni, 30% Cu; (5) unalloyed Cu; (6) 98% Cu, 2% Zn; and (7) 95% Cu, 5% Al. WAT (13)

Caustic Embrittlement of Boiler Steel Continues to Exact Heavy Toll. S. T. Powell. *Steel,* Vol. 97, July 22, 1935, pages 36, 38. Abstract of part of the Edgar Marburg lecture before the American Society for Testing Materials, 1934. See "Water as an Engineering and Industrial Material," *Metals & Alloys,* Vol. 6, July 1935, page MA 301L/9. MS (13)

Corrosion Tests in Various Refinery Services. J. E. Pollock, E. Camp & W. R. Hicks. *Metals Technology,* Aug. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 639, 19 pages. Over 200 metals and alloys were tested in different refinery services by hanging small samples of the materials in the operating units and determining the amount of corrosion over a given period. The corrosion products were removed in accordance with procedure outlined by the A.P.I. and the weight losses are expressed in in. penetration per yr. Weight losses are tabulated and are briefly discussed. JLG (13)

Use of Chromium Nickel Alloys in Chemical Industry (Die Verwendung von Chrom-Nickel-Legierungen in der Chemischen Technik). R. Hanel. *Chemische Fabrik,* Vol. 8, Jan. 9, 1935, pages 8-12. Corrosion resistance data against acids, other chemicals and foods, and resistance to oxidation at elevated temperatures are given for Ni, Cr-Ni and Cr-Ni-Fe alloys containing 80% Ni, Cr-Ni alloys with and without other elements containing 40-60% Ni, and Cr-Ni steels, including 18-8 steel. 9 references. CEM (13)

A Study of Yellow Stain on Tinplates. C. E. Beynon & C. J. Leadbeater. *Sheet Metal Industries,* Vol. 9, May 1935, pages 289-292, 303. See *Metals & Alloys,* Vol. 6, July 1935, page MA 304L/4. AWM (13)

Cadmium as Rust Protection (Kadmium als Rostschutzmittel). L. Nernst. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, July 27, 1935, pages 920-922. Cd deposits adhere very firmly on steel, Fe, Al, Al alloys, Cu and brass and are entirely free from pores even in very thin layers. The deposits are, therefore, very flexible. The protective quality is due to the fact that the H developed in the electrolysis is not absorbed in the metal as in Ni and Cr but escapes, and pores can easily be closed by subsequent polishing. Under the influence of the atmosphere, a very finely adhering film of oxides or basic salts of Cd is formed which increases the protective action of Cd still more, but destroys the silver-like appearance. The latter can be retained by a thin coat of nitrocellulose lacquer. Cd deposits do not tarnish in air containing H_2S. Cd plated sheets can be rolled out to very thin sheets without destroying the protective Cd layer, and Cd on bolts does not come off but fits the thread and makes the interstices between bolt and nut airtight. Cd is less attacked by chemicals than Zn, is easily dissolved in dilute HNO_3, little by dilute HCl and H_2SO_4, and very little by organic acids. Alkalies hardly attack Cd, except NH_3 in presence of O and soluble cyanides. At temperatures above 250° to 300° C., a yellow-brown oxide is formed which comes off easily and does not protect the Cd layer. The hardness of Cd is slightly better than Sn but not as great as that of Zn; Cd deposits are, therefore, mechanically little resistant; this can be improved by alloying Cd with Zn and Hg, which has the further advantage of increasing the rust-protective action against sea water. The eutectic Zn-Cd alloy is recommended for this purpose. Cd is used as intermediary layer under Ni and under Cr instead of Cu Cd gives the same protection as other metallic deposits in thinner layers because of its denseness. 33 references. Ha (13)

Effect of Width of Cracks upon Rusting (Der Einfluss der Rissbreite auf den Angriff durch Rost). N. J. Renger. *Beton & Eisen,* Vol. 34, May 20, 1935, pages 161-162. Reports on experiments in the Testing Laboratory of the Municipal Police for Buildings, Haag. It is shown that cracks of only 1-2 mm. width promote rusting in reinforced concrete. Rusting was also noticed after half a year exposure due to cracks of only 0.3 mm. width. WH (13)

Resistance of Metals, Especially Rustless Steel, to Corrosion in Cooling Brines (Die Korrosionsbeständigkeit metallischer Werkstoffe, insbesondere von nichtrostendem Stahl in Kühlsolen). P. Schafmeister & W. Tofaute. *Molkerei-Zeitung,* Vol. 49, Mar. 19, 1935, pages 590-593. Cast steel is more resistant to a 21% NaCl brine at pH 12.5 than at pH 4.0. The influence of the reaction is even more marked in the case of a 23% $CaCl_2$ brine. Likewise, Cu is more resistant in an alkaline than in a neutral chloride brine; this is not true of Zn and Al. Corrosion of steel is decreased by adding 0.4% soda to a $CaCl_2$ brine or 1% to a NaCl brine; also by adding chromate, silicate, organic colloids or buffers. V2A steel is one of the most resistant metals for the construction of compressors, pipes and coils. A 20 to 25% NaCl solution containing 1% soda is a satisfactory brine. Corrosion of metal surface is influenced by the composition of the brine, by the temperature, by the presence of dissolved O_2, and by galvanic action. V2A steel with a polished surface undergoes less galvanic corrosion than Ni, Cu or Cu alloys. The measured value for galvanic current was found to be not as great as the calculated value, because of the large area of cathodic V2A steel surface compared to the small area of anodic surface, and because of surface resistance due to rust. Galvanic corrosion is of less importance than natural chemical decomposition. GPS (13)

The Protection of Magnesium Alloys Against Corrosion. H. Sutton & L. F. Le Brocq. *Journal Institute of Metals,* Vol. 57, July 1935, pages 343-364, Advance Copy No. 709. Short-time chromate treatments of 2 types of Mg alloys in common use were investigated. Protective value of these treatments was compared with the 6-hr. chromate treatment and other forms of protective coatings. A chromate bath was evolved which gave good protective films in 30 to 45 min. and could be used in a steel tank. The protective values of the different treatments were investigated by corrosion tests of treated specimens with and without supplementary coatings of varnish and enamel. Intermittent sea-water spray laboratory tests and beach exposure tests were made and the corrosion measured by loss in weight and change in mechanical properties. For preparing pieces for chromate treatment, simple immersion in a hot alkaline bath of carbonate-silicate-oleate was found to give better protective effect of the subsequent chromate treatment than treatment in causic soda solutions with or without electric current. 6 references. JLG (13)

Developments in Steam Turbines II. C. R. Soderberg. *Mechanical World & Engineering Record,* Vol. 47, June 28, 1935, pages 637-641. Part of the paper is devoted to corrosion and erosion occurring in steam turbines. It is generally realized that satisfactory results for the high blade speeds can be obtained only by protecting the back of the inlet edge with shields having a hardness in excess of 500 Brinell. Stellite has been found to be one of the best materials for this purpose. High speed erosion tests in the laboratory have been verified in actual practice. The specially designed erosion tester and a set of specimens are shown. Typical testing results on different materials were:

Material	Hardness in Vickers-Brinell	Length of test in min.	Loss of weight in %	Loss/min. in %	Comparative corrosion resistance
12% Cr-steel with stellite shield	600	30	0.9	0.030	6.3
12% Cr-steel	225	20	3.8	0.190	1.00
tantalum	150	8	2.7	0.337	0.56
5% Ni-steel	172	4	1.7	0.425	0.45
nitralloy	200-900	11	1.0	0.091	2.10

Moisture drainage from the last stages of a turbine has been found to be one of the most effective means of reducing corrosion. WH (13)

Possibility of Standardization of Corrosion Data (Ueber die Möglichkeit einer Normung von Korrosionsangaben). F. Tödt. *Aluminium,* Vol. 17, July 1935, pages 392-393. The possibility of standardizing losses by corrosion is discussed and the various factors entering into the problem, as surface condition, loss of material, size of specimens, method of testing are reviewed. Ha (13)

Something about High-Heatproof Rust-protective Coatings (Einiges über hochhitzebeständige Rostschutzanstriche). F. J. Peters. *Korrosion & Metallschutz,* Vol. 11, Aug. 1935, pages 179-183. Behavior of rust-protective coats with binders or organic substances under influence of heat up to 400° C. is reviewed. Kerosene and pitch cannot be used as they become too soft even at 150°-200° C. Natural asphalts, although brittle, give protection up to 250° C. Lacquers with a base of chlorine-caoutchouc are fairly resistant up to 150°, acetyl cellulose up to 100°. Only lean (not fatty) binding agents rich in resins should be used for such paints. As at 400° almost all binding agents are entirely disintegrated, the residues of the agent must be such that they leave a continuous, well adhering coat on the metal to be protected. Durophen, Al bronze, Zn dust, with binders of this type give good results. Heatproof paints should never be sprayed on, but brushed on, except Zn dust which can also be sprayed. General points to be observed in treating the material before painting, selection of binders, fluidity of paint, adding of coloring agents are discussed. Ha (13)

Experiments with Additions to Water which Inhibit Its Attack on Light Metal (Versuche über den Angriff von Wasser auf Leichtmetall hemmende Zusätze). H. Röhrig. *Aluminium,* Vol. 17, Aug. 1935, page 418. Damage by water in machinery, especially where light and heavy metals are in direct contact so that electrochemical corrosion may occur by formation of local elements, can be avoided by adding oxygen liberating salts to the water, e.g. sodium chromate, or emulsifying oils. The passivation by the salt is very likely due to an increase in the thickness of the oxide film. The oil may act by depositing a fine oil film on the metal surface. The addition of 0.2% sodium chromate or 0.5-1% oil (corrosion-protective oil No. 54) proved to be effective for tap and sea water, also in weakly acid or alkaline water. Ha (13)

The Corrosion Problems of the Naval Architect. W. H. Hatfield. *Engineer,* Vol. 159, May 3, 1935, pages 456-457, 472-474; *Engineering,* Vol. 139, May 3, 1935, pages 471-472; June 21, 1935, pages 664-667. From a paper read before the Institution of Naval Architects. See *Metals & Alloys,* Vol. 6, July 1935, page MA 304L/9. LFM (13)

Corrosion: Its Nature and Effect on Selection of Production Equipment. W. St. M. E. Crake. *Oil & Gas Journal,* Vol. 33, Apr. 25, 1935, pages 18, 20, 85-86. Paper presented before Southwestern District, American Petroleum Institute, San Antonio, Tex., Apr. 25. The paper is presented in 4 main sections: (1) Theory of corrosion. (2) Field corrosion—preliminary data—dealing with the preliminary information required upon entering a new field in order to make decisions as to class of equipment to be used and the methods of installation with reduction of corrosion as the focal point. (3) Protective coatings—presents some remarks and data with respect to various types of protective coatings usable in the field and their suitability relative to the theory of corrosion. (4) Protection of field equipment—gives various suggestions and recommendations for protection of tankage, derricks, substructures, casing, tubing, sucker rods and pipe lines for various field services. VVK (13)

Application of Calorized Refinery Pipe Still Tubes. C. L. Clark, Roger Stewart Brown & A. E. White. *Oil & Gas Journal,* Vol. 33, Mar. 28, 1935, pages 44-45, 129. The new method of calorizing consists in calorizing in the usual way and then heat-treating the material, resulting in a further penetration of the Fe-Al alloy into the material rendering it susceptible to deformation without breaking the surface. Low alloyed materials can also be calorized. Creep data, tensile properties, hardness, and oxidation resistance are given for calorized mild steel, Mo-steel and Cr-Mo steel. VVK (13)

Aluminum and Its Alloys (L'Aluminium et ses Alliages). A. Dumas. *Métaux, Aciers Spéciaux, Métaux et Alliages,* Vol. 9, Oct. 1934, pages 399-403. Commercial Al is dissolved in less than an hour in a 30% HCl solution, while refined pure Al will take several days to dissolve completely. A 5% Si-Al alloy has very good corrosion resistance. Alpax (15% Si) with 0.3-0.5 Mg and Mn has excellent properties. Al alloys containing 4.5% Cu and 0.3% Ti have good corrosion resistance. Alloys containing 10-12% Mg and with some Mn and Cr possess good mechanical properties after a treatment of homogenization. GTM (13)

Progress in Metallurgy as Applied to Petroleum Refining. R. L. Duff. *Refiner & Natural Gasoline Manufacturer,* Vol. 14, Mar. 1925, pages 88-89. Points out the service conditions encountered by metals and alloys in petroleum refining and the requirements to be met. VVK (13)

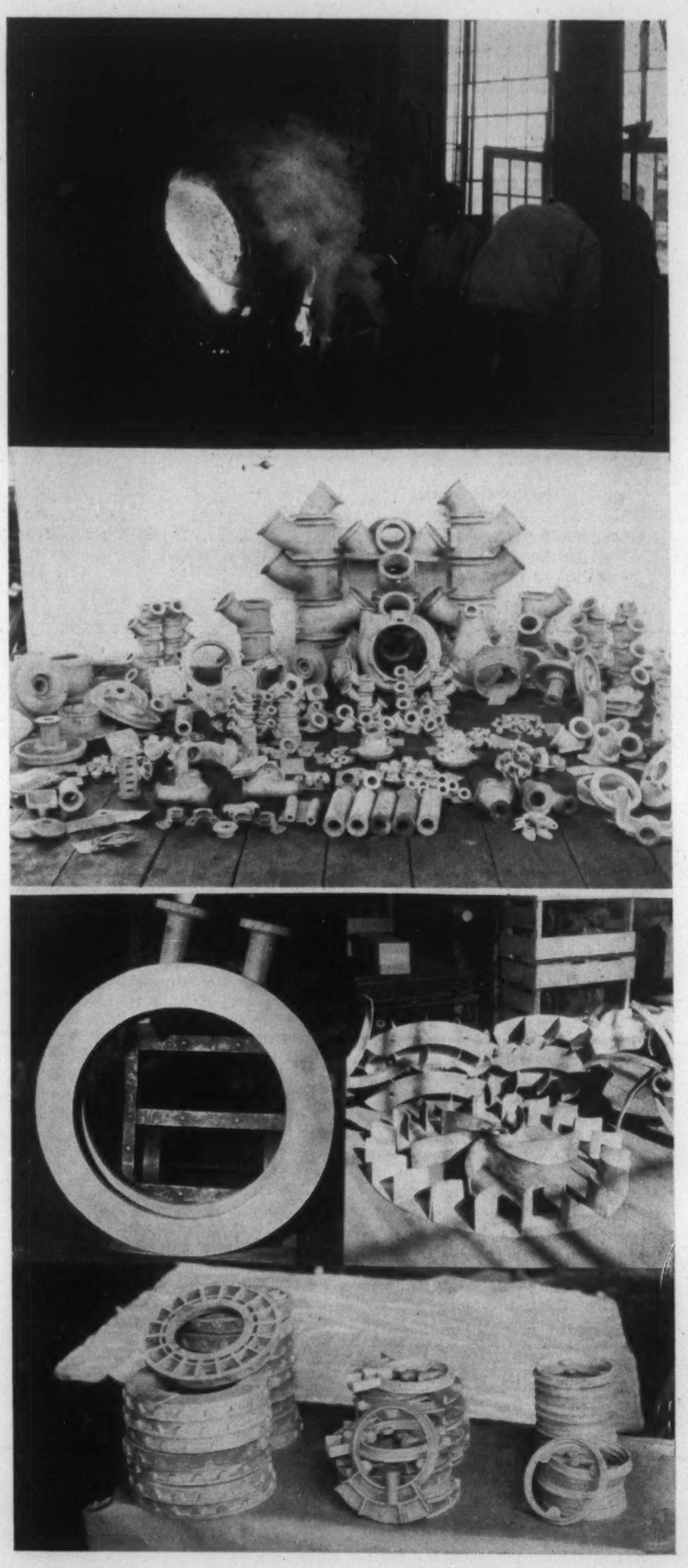
Aluminum Alloys and Alumags (Les Alliages d'Aluminum autoproteges, les Alumags). E. Drouilly. *Métaux, Aciers Spéciaux, Métaux et Alliages,* Vol. 9, Oct. 1934, pages 404-407. Alumags are not attacked by the following: Ammonium carbonate,-sulphite,-nitrate; sodium sulphate,-sulphite,-bicarbonate-dichromate,-phosphate; acetic acid, lactic acid and sugar solutions. GTM (13)

Marine Corrosion. J. W. Donaldson. *Metallurgia,* Vol. 12, Aug. 1935, pages 117-118. Brief review. JLG (13)

Materials for Condenser Tubes. Yoshiro Fujii. *Tetsu-to-Hagane,* Vol. 21, July 25, 1935, pages 568-575. In Japanese. 7 kinds of Cu-base alloys and 2 kinds of stainless steel were subjected to the measurements of the various properties for condenser tubes, that is, specific gravity, corrosion in 3% NaCl aqueous solution, erosion in sea water, various mechanical properties and microstructure. Further, the thermal conductivity was measured by an apparatus which was newly constructed using condenser tubes made of above materials. The small condensers which were specially constructed were tested using these tubes for 4 years. In these tests the following alloys showed good results;

Hiro-ken (The Hiro Naval Arsenal) A alloy; 3% Al,
16% Zn, rest Cu
Brass; 27% Zn, 1% Sn, 0.03% Fe, rest Cu. TS (13)

Salvaging of Producing Equipment in West Texas Damaged by Corrosion. Robert W. Harrison. *Oil & Gas Journal,* Vol. 34, Aug. 15, 1935, page 40. Reprint of article in the June issue of the Colorado School of Mines "The Mines Magazine." This article presents the methods used, cost statements and salvage values in plugging and abandoning pumping wells in the Big Lake Field of Reagen County, Texas. Considerable data from some 22 wells are included on the various items of equipment salvaged. VVK (13)



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Care and Appreciation of Gas Holders. W. T. Jebb. *Gas Age-Record,* Vol. 75, Mar. 9, 1935, pages 213-216. Paper presented at the Ninth Annual Business Conference of the New England Gas Association, Feb. 1935. A general discussion of the maintenance of gas holders, causes of corrosion, lubrication, painting, etc. VVK (13)

On the So-Called "Bluten" of Steel (Über das sogenannte Bluten des Stahles). A. Leon. *Montanistische Rundschau* (Section *Stahlbau-Technik*), Vol. 27, July 16, 1935, pages 1-2. When two steel surfaces are pressed together under a heavy load, or when they are subject to sliding or rolling contact under high pressure, the surfaces frequently take on a thin protective film of oxide, a phenomenon for which German metallurgists have adopted the terms Bluten (bleeding), Schwitzen (sweating) or Verprellen. Chemical analysis and X-ray examinations have shown that the oxide layer is quite different from ordinary rust, and that it consists of Fe_2O_3 and Fe_3O_4, mixed with minute particles of metallic Fe. Experiments in a N atmosphere have failed to produce any such effect on steel surfaces. The frictional oxidation, as it may be termed, has also been observed when V2A steels have been subjected to rolling and sliding on each other in the presence of oxygen. Formation of the oxide layer resembles to some extent the well-known temper colors. An increase in the temperature due to the high pressure only partly explains the phenomenon. The main cause is probably the adsorption of oxygen on the metal surface. The high pressure to which the oxygen is exposed by the pressing, sliding, or rolling will then greatly increase the rate of the oxidation. BHS (13)

Cathodic Protection of Pipe Lines from Soil Corrosion. Robert J. Kuhn. *Gas Age-Record,* Vol. 75, Apr. 6, 1935, pages 337-338, 342. Paper presented at the Southern Gas Association, Dallas, Tex. Feb. 20, 1935. Account of the use of cathodic protection for 16" and 20" trunk gas lines in New Orleans where the soil is very corrosive. VVK (13)

Uniform System to Determine Extent of Corrosion Losses Is Necessary. O. A. Knight. *Oil & Gas Journal,* Vol. 34, July 4, 1935, page 39. Corrosion losses in the gas and oil industry and the theories of corrosion are reviewed. A uniform system of determining corrosion losses should be used. VVK (13)

Corrosion Resistance of Ni, Cu-Ni Alloys and Inconel (Résistance à la Corrosion du Nickel pur, des Cupro-Nickels, des maillechorts et de l'Inconel. Applications qui en découlent). F. Renaud. *Métaux, Aciers Spéciaux, Métaux et Alliages,* Vol. 9, Oct. 1934, pages 387-398. General review of physical and chemical properties of Ni and Ni alloys. GTM (13)

Continuous-Flow Corrosion Tests of Steel Pipe. H. S. Rawdon & L. J. Waldron. *Preprint American Society for Testing Materials,* June 1935, 9 pages. Ordinary laboratory corrosion tests, due to limitations imposed by the small size of the usual specimen, the relatively short duration of the test and the failure to simulate the essentials of the conditions expected in service, are generally inadequate for predicting performance in service. The test described is really a short-time service test rather than an extended laboratory test. The method consists in circulating water of known characteristics through a system built up of sections of ferrous pipe material. A number of specimens approximately 5" long, after being cleaned and weighed, were assembled, with intermediate hard rubber spacing rings, to form a vertical water-tight column. After being subjected to water flowing at a controlled rate for the desired period, the columns are disassembled and the specimens properly cleaned, weighed and the corrosion rate determined. Results obtained on 2" pipe of 2 open-hearth steels showed: (1) the distribution of corrosion was affected by the degree of turbulence in the flow, straight-line flow being necessary for most satisfactory results; (2) corrosion of specimens varies with position in the column, the rate being a maximum at the inlet end with a progressive decrease along the column, which effect can be largely overcome by increasing the rate of flow; (3) pipe used successively from one series of tests to another, the specimens being cleaned at the end of each run, showed an apparent increase in corrosion rate with increased use, attributable to roughening of the surface—a factor which is not usually taken into consideration; (4) the distribution of the corrosion of pipe in ordinary tap water was affected by the scale deposition occurring simultaneously with corrosion. A mottled appearance resulted, certain areas constituting a general net-work showed practically no corrosive attack. However, the "over-all" corrosion rates of specimens corroded under such conditions were very uniform. In a more corrosive (softened) water the scatter in the results was much more pronounced. VVK (13)

Corrosion Testing Methods. H. E. Searle & F. L. LaQue. *Preprint American Society for Testing Materials,* June 1935, 12 pages. The authors emphasize the importance of field corrosion tests rather than laboratory tests and describe the spool-type specimen holder which is designed to permit a number of specimens to be exposed under actual operating or field conditions. The specimens are discs 2.233" in diameter with a 21/64" diam. hole in the center, 1/32" thick, mounted on an insulated rod with insulated spacers. Where necessary, strips can be used in place of discs. The whole is mounted ruggedly and can be inserted in any operating unit. Based on 8 years of experience in the use of this and other devices, the authors consider it to be the most practical yet developed. Examples are given to illustrate the accuracy with which performance in service has been predicted through its use. The suggestion is ventured that standardization of apparatus for field corrosion testing will be of greater immediate utility than a similar standardization of laboratory testing equipment. VVK (13)

Method for Testing Resistance of Stainless Steels to Pitting (Metod för provning av rostfria stals beständighet mot pittingsbildning). Sven Brennert. *Jernkontorets Annaler,* Vol. 119, July 1935, pages 281-295. The principle of the method is to measure the potential of the specimen against a standard calomel electrode in the test solution while a small current is passed through the solution. With no current passing the electrode potential characteristic of the metal is obtained. The specimen is then polarized anodically and a small current passed. Time-voltage and time-amperage curves are taken, and the time at which the current increases sharply gives a potential which is called the "break-through" potential, at which it is supposed that the protective surface has been punctured. The difference between the normal calomel potential and the "break-through" potential is therefore considered a measure of the pitting resistance. The original must be consulted for detailed sketches of arrangement to prevent current from breaking through at the edges of the specimen rather than the surface. HCD (13)

14. APPLICATION OF METALS AND ALLOYS

Stainless Steel Construction. W. L. Sutton. *Aero Digest,* Vol. 27, July 1935, pages 40-42. Welding of stainless steel is discussed. Design of stainless aircraft float gave larger displacement per lb. of weight than a similar design Al alloy float thus making the former about 30% lighter. Both can be produced at about the same cost. Stainless gasoline tanks also are lighter per gallon of gasoline than Al tanks. WB (14)

Metal Airplane Construction. Alexander Klemin. *Aero Digest,* Vol. 27, July 1935, pages 43-45, 112. Advantages of metal construction as compared with wood are discussed. WB (14)

Fitting Design and Materials. J. L. Harkness. *Aero Digest,* Vol. 27, July 1935, pages 46-50. The design of fittings and use of various metals for castings, sheet and wrought metal used in aircraft are discussed. WB (14)

Steam and Diesel Equipment Using More Corrosion-Resisting Materials. *Product Engineering,* Vol. 6, Nov. 1935, pages 411-414. Examples and diagrams illustrate the increased use of alloy cast Fe, stainless and alloy steels, Monel metal, nitralloy and hard-facing in various machinery. Ha (14)

Instrument Designers Lead Way in Using Expensive Metals. *Product Engineering,* Vol. 6, Nov. 1935, pages 430-432. Illustration of uses of stainless steel, Be-Cu, Al alloys and Monel metal to improve performance and weight of instruments. Ha (14)

14a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Aluminum in the Chemical, Food and Allied Industries (L'Aluminium dans les Industries Chimiques Alimentaires et Industries Connexes). Bureau International des Applications de l'Aluminium, Paris, 1935. Cloth, 5½ x 8½ inches, 137 pages.

This brochure, covering the uses of aluminum in the chemical and food industries, is the coöperative work of the French, Swiss, English, and German aluminum industries. After some introductory chapters of a general nature dealing with the chemical resistance of aluminum, working and joining of aluminum, and surface treatment, the remainder of the booklet is devoted to the consideration of the behavior of aluminum in the presence of various chemicals, drugs and food products. The extent of this treatment will be realized from the statement that the index lists over 350 materials as being discussed in the text. The booklet is well illustrated and pays quite a tribute to American practice in these fields, since over one-third of the photographs are of American chemical equipment.

Junius D. Edwards (14a) -B-

Light Metals and Their Application in Railroad Practice (Leichtmetalle und ihre Verwendung im Eisenbahnwesen). F. Reidemeister. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 90, Jan. 15, 1935, pages 32-38. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 420L/10. WH (14a)

Silver May Answer Your Corrosion Problem. B. A. Rogers. *Chemical & Metallurgical Engineering,* Vol. 41, Dec. 1934, pages 631-633. A discussion is given of the properties of Ag which are of significance in the use of the metal as a material of construction of equipment. The types of construction available for such equipment and the methods of joining Ag or composite Ag and base metal parts are mentioned. See also "Sheet Silver for Chemical Equipment," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 420R/8. PRK (14a)

Alloy Specialization for Oil Industry Usage Is Now Highly Developed. L. P. McAllister. *National Petroleum News,* Vol. 27, July 10, 1935, pages 26, 28, 30. The use of low alloy steels (2.0% Ni; 1.40% Mn-0.13% V; 1.25% Mn-0.50% Cr-0.75% Si) for the oil industry is rapidly increasing. Tables of properties are given. VVK (14a)

Non Ferrous Metals in Aircraft and Engine Construction. J. B. Johnson. *Aero Digest,* Vol. 27, July 1935, pages 26-28. A chart is presented of various non-ferrous metals under U. S. government specification with heat treatment, composition, mechanical properties and uses given. Brief discussion. WB (14a)

Non-Ferrous Metals and Alloys in General Engineering Practice. Josiah W. Jones. *Metal Industry,* London, Vol. 46, Jan. 11, 1935, pages 39-43, 65. The author describes some of the properties which modern metals and alloys must possess to satisfy present day conditions and deals with their application in several fields. HBG (14a)

Wrought Aluminum Alloys for Structural Applications. E. H. Dix, Jr. *Pennsylvania State College, Bulletin* No. 18, 1935, pages 113-127. Al-Mg and Al-Si alloys are the lightest and Al-Zn the heaviest. The modulus of elasticity is not affected appreciably by the various alloying elements. Weight and strength comparisons with steel are made. The properties of various Al alloys and their chief fields of usefulness are reviewed. AHE (14a)

Railway Bearing Metals in the United States (Lagermetalle im Eisenbahnwesen der Vereinigten Staaten). Witte. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 89, Nov. 1, 1934, pages 400-402. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 542. WH (14a)

Use of Magnesium Alloys in Aircraft Construction. E. Player. *Metallurgia,* Vol. 12, June 1935, pages 61-65. Discusses properties of Elektron alloys and their use in aircraft construction. JLG (14a)

Tantalum Capacitators. Bernard H. Porter. *Transit Journal*, Vol. 15, Aug. 1935, pages 14-15. Ta offers the advantages over Al for electrolytic condenser construction of very low internal resistance, its oxide is not soluble in the electrolyte, and it resists the corrosive action of all chemicals, except strong caustic alkalies and mixtures containing HF. The negative electrode of the Ta cell may be of any material not soluble in the electrolyte, pure Mo and Mo-W being satisfactory for use in H_2SO_4 solutions. Ta capacitors may be used in suppression of radio interference, as a filter of large capacitance for use in many radio power circuits, also as low-pass electric wave filters. Other uses are listed. WHB (14a)

Twenty-Five Years Light-Metal Pistons (25 Jahre Leichtmetall-Kolben). Ernst Mahle. *Aluminium*, Vol. 17, July 1935, pages 355-369. Development and ways and means to overcome mechanical and thermal difficulties are outlined. Modern constructions which satisfy the high mechanical requirements are described and illustrated. Ha (14a)

Aluminum in the Building Industries (Aluminium im Bauwesen). E. Herrmann. *Aluminium*, Vol. 17, Aug. 1935, pages 423-440. The many various forms of use of Al in interior decoration and in the interior of buildings are discussed and illustrated by many photographs. Descriptions of special profiles, method of handling and uses as heat insulating material are given. Ha (14a)

Beryllium. A Short Review of Its Preparation and Use (Beryllium. Ein kurzer Überblick über seine Gewinnung und Verwendung). W. Hessenbruch. *Metall und Erz*, Vol. 32, June 1935, pages 234-237. Review. 10 references. CEM (14a)

Copper and Its Alloys in the Construction of Modern Battleships (Le Cuivre et ses Alliages dans la Construction des Navires de Guerre modernes). M. Gossieaux. *Cuivre et Laiton*, Vol. 8, Aug. 15, 1935, page 337. Employment in boiler and condenser tubes, torpedoes, propellers and many fittings where corrosion must be reduced to a minimum, is briefly reviewed. Ha (14a)

Three Barreled Gun of Light Metal (Leichtmetall-Drillinge). C. Greim. *Aluminium*, Vol. 17, Aug. 1935, page 441. Good experiences are reported with a three barreled gun of 7 mm. caliber weighing only 2.7 kg. Ha (14a)

An "Electrodeless" Metal Vapour Lamp for the Production of Resonance Radiation. Fred Fairbrother & James L. Tuck. *Transactions Faraday Society*, Vol. 31, Mar. 1935, pages 520-526. Contains bibliography. Two types of metal vapor lamps are described which overcome self-absorption. Na, Cd, Th, Hg, and other alkali lamps have been prepared. The metal vapor is excited at very low pressures (10^{-4}-10^{-5} mm.) by an alternating potential at a frequency of 10^8 cycles/sec. Measurements are given of the absorption of the resonance radiation for such lamps containing Na and of the change in intensity and character of the light with increase in temperature of the lamp. PRK (14a)

Aluminium Alloys in Naval Construction. W. C. Devereux. *Shipbuilding & Shipping Record*, Vol. 45, May 16, 1935, page 553. The protection of Al and its alloys from corrosion by sea water is discussed, and suggestions are made for their more extended use for parts such as deck and cabin fittings and for marine engine parts. JWD (14a)

Plating Reflectors with Indium. C. C. Downie. *Metal Progress*, Vol. 28, July 1935, pages 56, 58. Indium plated reflectors are said to reflect light in manner hitherto unknown and with a faithfulness not observed with other metals. Plating with this metal is simpler than with other precious metals but improvement in reflectors by its use awaits the development of an economical extraction method. WLC (14a)

Progress in Plumbing Fixtures of Brass and Bronze (Les Progrès de la Robinetterie en Laiton et en Bronze). A. Chaplet. *Cuivre et Laiton*, Vol. 8, Aug. 15, 1935, page 325-331. The various types used in France are described. Ha (14a)

Inspection of Aluminum Bridge Floor. *Engineering News-Record*, Vol. 115, Aug. 15, 1935, page 215. Floor framing and decking of the Smithfield Street bridge in Pittsburgh were inspected after 7 months service. Excellent conditions were reported. The paint coating was also in first class condition. CBJ (14a)

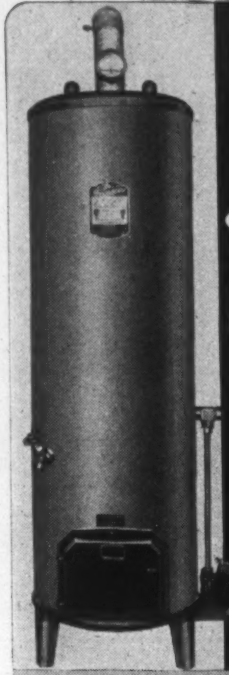
All-Aluminum Coaches in the United States (Ganz-Aluminiumwagen in Amerika). *Organ für die Fortschritte des Eisenbahnwesens*, Vol. 90, June 15, 1935, page 220. Describes the all-Al Pullmans exhibited at the World's Fair, Chicago. Total weight savings of 50% due to the adoption of Al alloys is emphasized. WH (14a)

Insulated Lead-Coated Copper Roof. *Sheet Metal Worker*, Vol. 26, Aug. 1935, pages 356-358. Details of construction of a roof of Pb coated Cu sheets with cork insulation are described. Ha (14a)

The Uses of Lead on Board Ship. *Shipbuilder & Marine Engine Builder*, Vol. 42, Apr. 1935, page 221. Pb in sheet form is used as a lining in pantries, galleys, and refrigerating chambers in passenger and cargo ships, and under certain deck fittings, to prevent corrosion of the steel plating below. As pipes it is used for plumbing in high-class passenger ships and for bilge and ballast pipes in all classes of ships. JWD (14a)

Tin in Bearing Metals. *Tin*, Aug. 1935, pages 8-9. The growing economical value of tin metal with the growing mechanization of life is commented on and the consumption of Sn in the particular field as a bearing metal and the properties of the different bearing alloys discussed in a general way. Ha (14a)

Nickel Alloys in the Architectural Field. G. F. Geiger & R. E. Case. *Industrial & Engineering Chemistry*, Vol. 27, Oct. 1935, pages 1130-1132. Ni alloys are finding considerable use in the architectural field, particularly for hardware, plumbing fixtures, architectural trim, and roofing. A study has correlated the compositions of certain Ni alloys with their colors and has established a basis for intelligent color matching with these alloys. The compositions and physical properties of important Ni alloys are discussed. MEH (14a)



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14b. Ferrous

M. GENSAMER, SECTION EDITOR

Stainless Steels and Vitreous Enameled Irons in Architecture. M. J. R. Morris & Karl Kautz. *Industrial & Engineering Chemistry*, Vol. 27, Oct. 1935, pages 1135-1137. The advantages of steel products as building exteriors are cited. See also "Metal for Housing, Stainless Steels and Enameled Iron," *Metals & Alloys*, Vol. 6, Sept. 1935, page MA 379R/6. MEH (14b)

New Materials for Permanent Magnets (Neue Werkstoffe für Dauermagnete). A. Kussmann. *Zeitschrift Verein deutscher Ingenieure*, Vol. 79, Sept. 28, 1935, pages 1171-1173. The most recent developments in magnetic materials are reviewed. The precipitation-hardened Fe-Co-Mo alloys and the Ni-Fe-Al alloys with about 25% Ni and 10% Al (recently with additions of Co, Mo, Cr) are important. Fe-Co-Ti (composition not given) gave the highest coercive force and best quality number ($= B_{max.} \times H_{max.}$) in this class, but was exceeded by a Pt-Fe alloy with 78% Pt having 1800 oersted and 4000 gauss and a 30% higher quality number. Practical application of the latter will be very limited on account of the high price, except in high-grade measuring instruments where only small amounts are required. 14 references. Ha (14b)

Light-Weight Welded Steel Members Used in New 10-Cylinder Radial Diesel. *Iron Age*, Vol. 136, Sept. 19, 1935, pages 30-31. Describes the construction of a 10 cylinder radial two-cycle Diesel engine developing 450 hp./900 r.p.m. by the Continental Motor Corp. Complete engine weighs 3900 lbs., a ratio of 8.66 lbs./H.P. Front of crankcase is welded assembly of high tensile Cromansil and S.A.E. 1020 C steels. Rear half is also welded by Cromansil, S.A.E. 1020 C steels and electric furnace steel castings. Main ring and web and all ribs are of Cromansil steel. All weld metal specimens showed yield point of 65,000 lbs./in.^{2}, ultimate strength of 95,000 lbs./in.^{2} and elongation in 2 in. of 24%. VSP (14b)

Heat Resisting 18-8 Steel Containing Silicon and Aluminum. M. M. Romanoff & O. I. Wer. *Metallurg*, No. 4, Apr. 1934, pages 43-52. In Russian. (1) Cr-Ni (18-8) steel containing 3% Si + Al has good mechanical properties at elevated temperatures, 600°-1000° C., and can be used in some places instead of NCT3 (25% Cr, 19% Ni). (2) Cr-Mn-Si-Al steel containing 18% Cr, 9% Mn, 2% Si, 1% Al, 0.19% C is very brittle at room temperature and it is worse than 18-8 at temperatures 600°-1000° C. (3) High Mn steel containing 20% Mn, 0.71% C, 4.34% Cr, 2.0% Si, 2.0% Al shows at 900° C. almost the same mechanical properties as does the steel NCT3; namely proportional limit 6.55 kg/mm^2, tensile strength—8.55 kg/mm^2, elongation—22.3%, reduction of area—61.8%. Too low working properties are mentioned as a disadvantage of this steel. VK (14b)

The Deep Drawing of Sheet Steel. L. B. Hunt. *Sheet Metal Industries*, Vol. 9, Feb. 1935, pages 101-103; Mar. 1935, pages 154-156. See *Metals & Alloys*, Vol. 6, June 1935, page MA 258L/4. AWM (14b)

New S.A.E. Steel Data Embody Wide Engineering Significance. F. P. Gilligan. *S. A. E. Journal,* Vol. 36, Apr. 1935, pages 1-20; *Heat Treating & Forging,* Vol. 21, June 1935, pages 286-288; *Industrial Standardization,* Vol. 6, Apr. 1935, pages 92-94. **Revised S.A.E. Specifications for Steels Announced.** *Steel,* Vol. 96, Apr. 1, 1935, pages 28-30, 32, 53. Opinions of various manufacturing executives are given relative to the new S.A.E. specifications. Pages 18-20 give several charts for physical properties of C and Cr-Ni steels and also the chemical compositions of a variety of automotive steels. WB + MS (14b)

Steels: Their Selection and Application in General Shop Practice. Frank J. Allen. *Pennsylvania State College, Bulletin* No. 18, 1935, pages 99-112. The properties of various steels, their most advantageous applications, possible substitutes, effect of changes in composition and treatment, etc. are discussed. See also *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 542. AHE (14b)

"Queensway," An Example of Metal Progress. F. G. Martin. *Metal Progress,* Vol. 28, July 1935, pages 54, 56. Describes vehicular tunnel in Liverpool, England, 2.13 miles long with 36 ft. road way in which 82,000 tons of cast Fe are used in tube and paving and held by a million bolts. WLC (14b)

Cylinder Bushings of Nickel Cast Iron (Zylinderlaufbüchsen aus Nickelgusseisen). E. Pohl. *Deutsche Motor Zeitschrift,* Vol. 12, June 20, 1935, pages 114-115. A pearlitic cast Fe (4 micros given) containing 1.2-2.0% Ni and 0.3% Cr has a Brinell hardness of 220-250 and is particularly suited for interchangeable cylinder bushings. For severe service conditions, a martensitic cast Fe with 4.5-6% Ni is utilized. By proper heat treatment, the martensitic structure can be developed in cast Fe containing only 3.5-4% Ni. The hardness of the martensitic material is 300-500 Brinell. The cylinder linings can be manufactured by sand and die casting. The latter method leads to a refined graphite distribution. The 6 most conspicuous advantages of Ni-bearing cylinder bushings are pointed out. WH (14b)

Steel Castings in Mining Operations. J. A. de Bondy. *Canadian Mining & Metallurgical Bulletin* No. 281, Sept. 1935, pages 453-457. Much Mn steel is used around mines and mills. The problems in producing, fabricating, and using Mn steels, especially the effect of heat on them, are discussed. AHE (14b)

Recent Developments in Materials for Permanent Magnets (Die neuere Entwicklung der Werkstoffe für Dauermagnete). F. Pölzguter. *Stahl und Eisen,* Vol. 55, Aug. 8, 1935, pages 853-859. Discusses the development of W and Co permanent magnet steels, the recent Al-Ni and Co-Ti precipitation hardening alloys and the steels used for various uses in practice, their heat treatment and performance. Several magnet designs are illustrated. SE (14b)

Practice in Building High Pressure Boilers (Aus der Praxis des Hochdruckkesselbaues). W. Seeberger. *Stahl und Eisen,* Vol. 55, Aug. 1935, pages 877-882. Details are given of high pressure boiler design and layout. SE (14b)

Report of Committee on Rail. *Proceedings American Railway Engineering Association,* Vol. 35, 1934, pages 829-878, *discussion* 1143-1147. Includes statistics of total rail failures and transverse fissure failures, and reports (so far encouraging) regarding the effect of heat treating the ends of rails in reducing rail battering. JCC (14b)

Large Uses of Steel in Small Ways. No. 293. Play Tables. *Steel,* Vol. 97, Aug. 19, 1935, page 30. Describes combination sand-box, play table, and toy chest for children made of sheet steel, channels, and flats, welded together. MS (14b)

Cast Iron Plate Roofing—A New Product of the Foundry. *Iron Age,* Vol. 136, Sept. 12, 1935, pages 10-14. Describes a new cast Fe roofing developed by the United States Pipe & Foundry Co. and known under the trade name of Usicast. This roofing is composed of a standard cast Fe plate and cap plate. The former is a single casting of 3/16" thickness, 52" long and 24" wide. Each plate unit weighs 78 lb. The cap plate is semi-cylindrical and of same length as roof plate. It is recommended with roof slopes of not less than 4" in 12". Describes method of installation. VSP (14b)

Freight Containers Here and Abroad. *Iron Age,* Vol. 136, Oct. 24, 1935, pages 24-25, 90, 92. In Europe, especially in England, the use of freight containers is much more widespread than in this country. Gives brief discussion of British containers. Latest type of container in this country is a stainless steel unit made by Rustless Iron Corporation of America. VSP (14b)

The Low-alloy High-tensile Steels. *American Metal Market,* Vol. 42, Aug. 21, 1935, page 6. A brief enumeration of the alloys mostly used at present in industries and their makers. Ha (14b)

The Progress of Automobile Engineering. Henry Fowler. *Proceedings Institution of Civil Engineers,* Vol. 238, 1935, page 477. A reference is made to the improvement in material available for automobile construction and includes the special non-scaling steels used for valves and valve seatings; the Cr-Ni steels for gears; the Cr-V, Si-Mn and Si-Cr steels for springs; the nitrided steels; the light alloys of Al both cast and forged, the light alloys of Mg; and the use of Pb bronze alloys for bearings. JWD (14b)

Steel Tubes for Aeroplanes and their Welded Joints (Stahlrohre für den Flugzeubau und ihre Schweissverbindungen). W. Hoffmann. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Sept. 21, 1935, pages 1145-1148. The development and properties of steels used in the construction of aeroplanes are discussed; endurance strength and the often observed formation of cracks at the welds investigated. At present, the following facts can be considered as accurate; cracks occur only parallel to the weld seam and only when the work is not allowed to expand and shrink during welding. Cracks do not occur if the piece is free to move, if the C content is 0.3% and Si + P higher than 0.08%. Cracks were observed when the acetylene producer was overworked so that water vapor was formed; in general, impurities in the gases used for welding had the same effect. The tendency to form cracks is reduced by the Mn content which should be between 0.7 and 1.5%, and counteracts the bad effect of an O content over 0.008%. Ha (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Modern Chemical Technology (Chemische Technologie der Neuzeit). Vol. II, Part 1, Edited by Otto Dammer. Vol. II, Part 2, Edited by Frans Peters & H. Grossmann. Ferdinand Enke Verlag, Stuttgart, 1932 and 1933 respectively. Cloth, 7¾ x 10¾ inches, 876 and 888 pages. Price 79 RM and 98 RM.

Three authors share in the first part of Vol. II, which comprises (a) "Technology of Metals and Alloys" by M. Frh. von Schwarz; (b) "Surface Protection of Metals, Coloring, Electro-Plating" by D. von Hagen and (c) "Handling of Ores Preparatory to Smelting" by F. Peters. In 362 pages, Prof. von Schwarz deals with the physical properties of metals and alloys in general and then discusses the following pure metals and their alloys: Cu, Ni and Co, Al, Mg, Li, Be, Mn, Cr, W, Mo, Ti, V, Ta, Hg, As, P, Sn, Pb, Zn, Cd, Ag, Au and Pt metal group. Two unique features characterize this part of the book. In the first place an alphabetic collection of (mostly) non-ferrous alloys is given covering about 120 pages. Besides trade-name and chemical analysis, more or less thorough information is given on melting point, color, physical properties, chemical behavior, international patents granted. It is quite obvious that this condensed list of alloys presents a valuable wealth of data. The second "high-spot" or at least the underlying idea, is a 50 page collection of some 150 binary constitutional diagrams. Apparently these have been taken from Landolt-Börnstein. A close inspection unfortunately reveals that the majority of diagrams and references dates back to the time of from 1900-1914, when thermal analysis and microscopic evidence were used for the establishment of constitutional diagrams. It is generally admitted, that X-ray investigations in the solid state in innumerable cases did not confirm these diagrams 20-30 years old. It is very disappointing that Dr. v. Schwarz, the author of many metallurgical papers, did not bring these diagrams up-to-date or at least endeavor to include literature statements later than 1926 and X-ray findings. The homogeneity ranges of the various phases could have been easily included at the foot of each diagram in a simple fashion shown for instance in Glocker's book. In the present form these 50 pages appear to be of rather limited use. The ternary diagrams are discussed in general and supplemented by a list of references extending to 1926. V Schwarz, v. Hagen and Peters treat their subjects very thoroughly, although not critically. By extensively citing the original patent, publication, dissertation, etc., the responsibility for the statements is passed onto the author of the original text. Thus the book becomes a skyscraper of references. But the well-known Dammer is intended to be primarily a reference book. It is evident, that a heavy burden is taken over from the former edition, whereas more recent advances are somewhat handicapped. Thus the chapters on electro-plating are not quite up-to-date, which is partly due to the progress made in the meantime but partly due to the fact that the literature survey stops at 1928. In Peters section of the book (390 pages), grinding, screening, ore dressing, roasting and calcining as well as the auxiliary equipment are described. Flotation gets 100 pages, 20 of which list flotation agents. Although the Dwight-Lloyd and his offspring cannot at all complain of being overlooked, the extensive chapter on roasting might justly be called "Evolution of Roasting Methods and Furnaces" Naturally, such a historical review includes some species only to be found in a museum. In many cases the earlier and later models of a single designer are shown. The late Dr. Peters' contribution is probably the most exhaustive treatment of the subject to be found in the international literature. There are 14 authors who contributed chapters to the second part of Vol. II, which deals with Fe and steel, Pt and Pt metals, Al, Mg, Na, Ca, Be-, Ce-alloys, Ni and Co, Ag, Cu, Sn, Sb, Zn, Cd, Ta, As, Hg, Bi, Pb, Cr, Mo, W, V, Nb, Ta, Ti, U, Mn, Re, Ga, In, Ge. It is obvious that this congregation of authors treat their subject in an individual manner, although generally spoken, the following scheme of treatment is observed: history, occurrence, ore dressing, metallurgical smelting and refining processes. Utilization and properties are more or less touched upon with the exception of the chapter on Fe, which comprises 40 pages on special steels. The distribution of space is in the same fashion as in part I. For instance, whereas the history of Fe is assiduously peddled on 4 closely printed pages, the nitriding process is dismissed with 16 lines. Be is luckier, it got 1¼ pages. Whereas thoroughly established processes are attacked boldly and tackled thoroughly, most authors change to cautious sparring when being confronted with the latest developments. It appears that the Dammer could stand an injection of theory. The present edition apparently places emphasis on facts and much attention is given to numerical results and statistics. The chapters on Ca, Be, Nb, Ta, U, In, Ge (Cr, Mo, W, Ti) are rather meagre and fall short of other books. Dammer has always been an outstanding reference book, and the new edition with its maze of information will undoubtedly reserve its traditional place. However, there are 2 factors which greatly detract from this special mission of the Dammer. Whereas libraries and similar institutions will gladly welcome the new edition, the American reader as an individual will frown at size and price when hauling more than 10 lbs. onto his desk. Both can be cut down without endangering the value of the book. Due to the distribution of the subject among so many authors, innumerable repetitions and presentation of the same illustrations occur. Processes abandoned in the last century should be left buried in older editions and not dragged ad infinitum through the newer ones. It is highly deplorable that part I does not contain an index. For intelligent use of the first part as reference book, one is thus compelled to buy the second part. On the other hand, both parts contain a list of some 400 periodicals (key for abbreviations) which have been consulted. Either both parts of Vol. II are an indivisible whole or not. If not, we would prefer to have an index in both parts instead of that list of 400 periodicals. The latter covers foreign journals, although domestic ones enjoy preference, as for instance, the "Archiv des Apothekervereins im nördlichen Deutschland," "Concordia, Zeitschrift der Zentralstelle für Arbeiterwohlfahrtseinrichtungen." If periodicals are included which tell us as much about metallurgy as the Bronx Home News or Saturday Evening Post, we feel, that, for the sake of justice, "Metals & Alloys" should be found on that list, too. The habit of referring to abstracts in German journals instead of the original paper should be abandoned. In summary: the 2 new volumes can be recommended to all libraries, institutions and individuals who can afford to buy them. Erich Fetz (15)—B—

German-English Chemical Terminology. An introduction to Chemistry in English and German. Alexander King & Hans Fromherz. D. van Nostrand Co., Inc., New York, 1934. Cloth, 5¾ x 8¾ inches, 324 pages. Price $5.00.

This is a bilingual book with the English and German text on opposite pages. More than 4000 terms in common use in chemistry are woven into the text. The opening chapters are fairly diffuse to meet the needs of beginners. The book has some defects: in some places the translation is too literal, while in others it is unnecessarily free, but this does not impair its value. The book provides a well-rounded vocabulary of chemical German. There are also appendixes devoted to atomic weights, mathematical expressions, abbreviations, and English and German indexes of the technical terms, which occur in the text. This volume is uniform with an earlier one in this series: German-English Geological Terminology by Jones and Cissarz. It is hoped that the series will be extended to include one on metallurgy. Richard Rimbach (15)—B—

Chemical Analysis of Aluminum. H. V. Churchill & R. W. Bridges. Aluminum Research Laboratories, New Kensington, Pa., 1935. Paper, 5¼ x 8¼ inches, 83 pages. Price 50c.

No one has had so good an opportunity to evaluate the speed and precision of the methods of analysis of aluminum and its high-aluminum alloys as has the Aluminum Company of America, nor is it likely that anyone else has as thorough appreciation of the importance and value of correct analyses. All suggested methods have been tried out over a long period of years and the less satisfactory ones weeded out. A favored few have had, in former years, mimeographed copies of the methods adopted by the Aluminum Company and have found them very helpful. A printed edition for general sale is now available Instead of making the methods mere cook-book recipes, helpful comment on why the methods chosen are advantageous and on the effect of interfering elements are included. Proper sampling is discussed and methods for the usual impurities in commercial Al, i.e., Si, Fe, Cu, Ti, on a single sample, and V on a separate sample, are given. Under determination of common alloying elements, Si, Fe, Cu, Mn, Zn, Ca, Mg, Ni, Cr, and Sn are dealt with, and under less common ones, Sb, As, Ba, Be, Bi, Bo, Ce, Cd, Co, Ga, Au, In, Pb, Li, Hg, Mo, Ag, Na, Sr, Ta, Te, W, U, V, Zr. References to the literature are profusely given. Practically everything one might wish to determine in Al is thus discussed with the exception of oxygen and phosphorus which are not mentioned. Every analyst dealing with Al and its alloys will find the pamphlet essential, and to contain a lot of information at low cost. H. W. Gillett (15)—B—

A Review of Recent Papers on Plasticity. A. Nadai. *Journal of Applied Mechanics, A.S.M.E.*, Vol. 2, Mar. 1935, pages A33-A34. Recent tensile tests made under high velocities of deformation, progress in the design of helical springs, stress fields and gliding phenomena in crystals are reviewed. 9 references. Ha (15)

Shop Practice in the Engineering Curriculum. E. D. Soderstrom. *Heat Treating & Forging*, Vol. 21, Mar. 1935, pages 115-116; Apr. 1935, pages 170-173. Shop courses should combine in small projects the fundamental facts of mechanics, metallurgy, chemistry, and physics as they pertain to control of working operations. Illustrates how basic understanding of ferrous metallurgy is developed in the course in forging and heat treating. Includes reproductions from student's note-book of pages dealing with heat treating diagram, temperatures at which heat treating is done, effect of time and temperature, pack hardening, and case-hardening. MS (15)

The Reconditioning of Defective Metal Parts. *Engineering*, Vol. 139, Apr. 19, 1935, page 415. Describes briefly the Gussolit welding and the Schliha metal spraying processes developed in Germany. Gussolit process consists of a high grade cast Fe alloy and part to be treated is heated from 850 to 900° C., coated with a flux and Gussolit welding rod melted into the crack. Schliha metal spraying is used for building up of worn engine parts. Metals such as bronze, Cu or Al are sprayed from a pistol. VSP (15)

The Production of Nickel Alloys. *Mechanical World & Engineering Record*, Vol. 47, May 31, 1935, pages 534-535. Cold rolling, annealing, hot rolling, rod and wire rolling, pickling, anode castings, and melting practice at the H. Wiggin & Co., Ltd., are outlined. WH (15)

Non-Ferrous Metals Research. *Engineering*, Vol. 139, June 28, 1935, pages 688-689. Brief summary of the researches outlined in the Annual Report for the year 1934 of the British Non-Ferrous Metals Research Association. LFM (15)

The American Dental Association's Affiliation with the National Bureau of Standards. R. H. Volland. *Journal American Dental Association*, Vol. 22, Apr. 1935, pages 618-625. Review of organization, progress, and present activities of Association's fellowship to study dental materials. The Bureau is represented by Drs. Souder and Schoonover, and the Association by Dr. Paffenbarger and Messrs. Sweeney and Beall. OEH (15)

The Metal Tungsten. William O. Vanderburg. *Heat Treating & Forging*, Vol. 21, Feb. 1935, pages 77-79, 87; Mar. 1935, pages 132-135. Reprinted from U. S. Bureau of Mines Information Circular 6821. See *Metals & Alloys*, Vol. 6, June 1935, page MA 260L/1. MS (15)

The Trend of Electrification in Steel Plants of the U.S.S.R. P. L. Letvin. *Iron & Steel Engineer*, Vol. 12, May 1935, pages 290-292. Descriptive. WLC (15)

Exhibition of Meteorites. L. Kulik. *Vestnik akademii nauk SSSR*, Vol. 5, Feb. 1935, pages 37-40. In Russian. Brief note concerning an exhibition of the collection of meteorites of the Academy of Sciences of the USSR which is the third-largest in the world. Reference is made to the origin of several unique ferrous meteorites. ORS (15)

High Hat Steels of Today. S. A. Knisely. *Heat Treating & Forging*, Vol. 21, June 1935, pages 280-282. Address before Iron and Steel Group, National Association of Purchasing Agnts. Outlines evolution of alloy steels and describes development by Republic Steel Corporation of an improved Bessemer steel and "Double Strength" steel. MS (15)

■ 15a. Economic ■

Gold Silver, Copper, Lead and Zinc in Montana. T. H. Miller. *United States Bureau of Mines, Statistical Appendix to Minerals Yearbook*, 1934, pages 373-407. Final figures for 1933. AHE (15a)

Mercury Industry in 1934—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports*, No. M. M. S. 372, May 17, 1935, 2 pages. Domestic Hg production (15.445 flasks) in 1934 increased 60% over 1933 and was slightly in excess of the 1924-1933 average. California contributed 51% of the total and Oregon 22%. AHE (15a)

Copper Industry in 1934—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports*, No. M. M. S. 374, May 28, 1935, 6 pages. Domestic mine and smelter production increased in 1934 to 478,640,000 and 488,454,107 lbs. resp. Stocks at smelters and refineries were reduced substantially and the average price improved. Imports into the U. S. made large gains, although over 90% was for treatment under bond and export. Domestic refinery production from imported ores was strikingly higher in 1934 and was almost as large as output from domestic sources; the proportion of refined Cu from foreign materials to that from domestic sources was the highest ever shown by the statistical record. Refinery production of new Cu from domestic and foreign ores was 890,719,865 lbs., from domestic ores 466,058,360 lbs. AHE (15a)

The Canadian Mineral Industry in 1934. John McLeish & Staff of the Mineral Resources Division. *Canadian Department of Mines, Mines Branch Report* No. 760, 1935, 119 pages. Short reviews of the 1934 Canadian production and sales of Al, Sb, Be, Bi, Cd, Co, Cu, Au, Fe, Pb, Mn, Mo, Ni, Pt, Ra and U, Se, Ag, Te, Zn, etc. AHE (15a)

British Columbia in 1934. W. A. McAdam. *Mining Journal, Centenary Number*, 1935, page 183. An economic review and forecast. AHE (15a)

Copper. E. E. Marshall. *Mining Journal, Centenary Number*, 1935, pages 34-35. The advance of the Cu industry from 1835 to 1935 is reviewed. AHE (15a)

Progress of Mining in Queensland. L. H. Pike. *Mining Journal, Centenary Number*, 1935, page 170. Statistical. AHE (15a)

Magnesite and Magnesium. W. G. Rumbold. *Mining Journal, Centenary Number*, 1935, page 42. A brief review. AHE (15a)

Zinc. O. W. Roskill. *Mining Journal, Centenary Number*, 1935, page 41. The Zn industry for 1934 is reviewed. AHE (15a)

Cadmium. O. W. Roskill. *Mining Journal, Centenary Number*, 1935 page 42. Uses and production of Cd are reviewed. AHE (15a)

Lead. O. W. Roskill. *Mining Journal, Centenary Number*, 1935, page 40. The Pb industry in 1934 is reviewed. AHE (15a)

Mining in Tasmania. James Balfour Scott. *Mining Journal, Centenary Number*, 1935, page 167. Statistical. AHE (15a)

Silver. E. Baliol Scott. *Mining Journal, Centenary Number*, 1935, page 30. The past 100 years of Ag production and trading are reviewed. AHE (15a)

Molybdenum. E. Baliol Scott. *Mining Journal, Centenary Number*, 1935, page 54. Production, consumption and uses of Mo are reviewed. AHE (15a)

Tin. E. Baliol Scott. *Mining Journal, Centenary Number*, 1935, pages 37-38. In the last 100 years, Sn has shown far less expansion in industrial uses and output than any other of the major metals. There has been no significant improvement in recovery methods for a long time. Smelting has shown the greatest technical improvement. Production and prices for 100 years are reviewed. AHE (15a)

Tungsten. E. Baliol Scott. *Mining Journal, Centenary Number*, 1935, page 56. A review. AHE (15a)

Nickel: Past and Present. Robert C. Stanley. *Mining Journal, Centenary Number*, 1935, page 44. The birth and rise of the Ni industry are reviewed. AHE (15a)

Alloy Metals in Steel and Iron. Julius L. F. Vogel. *Mining Journal, Centenary Number*, 1935, pages 51-52. The effect of Al, Cr, Co, Mg, Mo, Ni, Ti, W, V and Mn on steel is discussed. World production and sources in 1913 and 1933 for each are compared. AHE (15a)

Coal and Metallurgical Imports of Latvia. *Iron & Coal Trades Review*, Vol. 130, May 31, 1935, page 933. Statistics from the Report of the (British) Department of Overseas Trade. Ha (15a)

The Iron and Steel Industry in Japan. *Iron & Coal Trades Review*, Vol. 130, May 31, 1935, pages 943-944. Statistics from the Report of the (British) Department of Overseas Trade. Ha (15a)

Possibilities for Tin Consumption in China. *Tin*, June 1935, pages 4-5. Industrial applications of Sn metal in China are on the increase and a new industry to supply the demand is developing. Ha (15a)

Tin Consumption in Russia. *Tin*, June, 1935, pages 6-7. Statistics with particular regard to the automobile industry, are given. Ha (15a)

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Constructional Engineers and Steel Makers. *Engineer*, Vol. 159, June 7, 1935, pages 595-596. Editorial remarking on the advisability of an amicable agreement being reached between the constructional engineers and the steel manufacturers as to prices. LFM (15a)

Mining and Metallurgy in Roumania and Czechoslovakia (La Roumanie et la Tchécoslovaquie minières et métallurgiques). CH. BERTHELOT. *Revue de Métallurgie*, Vol. 32, Apr. 1935, pages 156-170; May 1935, pages 200-209. A brief survey. JDG (15a)

Antimony. CLIVE COOKSON. *Mining Journal Centenary Number*, 1935, page 38. Recent price increases are explained. AHE (15a)

Titanium—Its Supply and Economics. PAUL M. TYLER. *Metals & Alloys*, Vol. 6, May 1935, pages 131-133. Gives location of various foreign and domestic deposits of Ti ores with production figures. The wide spread between low cost of ore and high cost of ferro-alloy is explained by the difficulty of reduction and small consumption. WLC (15a)

The Mineral Industry of Uganda. B. B. WATTS. *Mining Journal, Centenary Number*, 1935, page 114. A review. AHE (15a)

Heating and Annealing Costs of Modern Sheet Rolling Mills (Wärme- und Glühkosten neuzeitlicher Blechwalzwerke). *Feuerungstechnik*, Vol. 23, Mar. 15, 1935, pages 33-34. Describes an up-to-date (Lauth) sheet rolling mill and modern annealing furnaces emphasizing the mechanical handling of the rolling stock. A critical comparison of the overhead expenses of an old and modern plant is made. The detailed data, of course, refer to German economic conditions. WH (15a)

The Japanese Tinplate Industry. *Iron & Coal Trades Review*, Vol. 130, June 14, 1935, page 1017. Economic conditions in Japan and statistics on productive capacity of this country are dealt with in the Report of the (British) Overseas Trade. Ha (15a)

The World Steel Trade Revival. *Engineer*, Vol. 158, Sept. 21, 1934, page 284. See "Fluctuations in World Trade in Iron and Steel," *Metals & Alloys*, Vol. 6, May 1935, page MA 215R/5. LFM (15a)

The Anglo-Continental Steel Pact. *Engineer*, Vol. 159, May 10, 1935, page 491. Editorial commenting on the agreement reached April 30, 1935 between the British and the Continental steel makers. The present arrangement is for a trial period of 3 months only during which time the imports of Continental steel are being limited to 160,750 tons which is at the rate of 643,000 tons per year. During this trial period arrangements covering the export market are to be negotiated. LFM (15a)

Southern Rhodesia's Record. *Mining Journal, Centenary Number*, 1935, page 106. A review. AHE (15a)

South Africa's Great Gold Industry. *Mining Journal, Centenary Number*, 1935, pages 73-74. A review of the 50 years life of the Witwatersrand. AHE (15a)

■ 15b. Historical ■

Dürener Metallwerke 1885-1935. VDI Verlag, Berlin, 1935. Paper, 8½ x 11½ inches, 90 pages.

This pamphlet commemorates the completion of 50 years existence of the firm which started as a small bronze foundry for the production of special alloys and came into prominence and large growth after the discovery of duralumin by Wilm. An interesting historical account of the discovery is given. The illustrations are especially good, and beautifully printed. The music of a Jubilee March "Light and Strong" is included. H. W. Gillett (15b) -B-

The Study of Technical History. I. N. LIPHSHITZ. *Mechanical Engineering*, Vol. 57, Mar. 1935, pages 143-147. An organization in this country devoted to study of engineering is advocated. Ha (15b)

British Blast Furnace and Open-Hearth Practice, 1910-1935. EDGAR C. EVANS. *Iron & Coal Trades Review*, Vol. 130, May 3, 1935, pages 743-745. Historical review, statistical data on ore consumption, production, type of furnaces and production of steel by different processes. Ha (15b)

Alexandre Pourcel, A Great French Metallurgist. A. PORTEVIN. *Metal Progress*, Vol. 27, May 1935, pages 58-59. Biographical eulogy. WLC (15b)

Pittsburgh Foundry Cast Guns. PAT DWYER. *Foundry*, Vol. 63, June 1935, pages 30-31, 71-72. Historical description of the Mackintosh-Hemphill Co. with a continuous record of 130 years in foundry work. VSP (15b)

Free Service Department For Readers of METALS & ALLOYS

Wanted:—By a well-known manufacturer of Heat and Acid Resisting Castings Sales Representatives who are acquainted with buyers and operating heads in the Steel, Automobile, Chemical and Oil Industries in the following territories: New York, Boston, Philadelphia, Chicago, Cincinnati, Houston and Birmingham. No objection to one or two more lines. Reply giving references and full information as to qualifications. Address Box MA-2, Care of Metals & Alloys, 330 W. 42nd St., New York, N. Y.

Lectrodryer

Bulletin DP discusses the Lectrodryer which was designed specifically for the drying of air, gases, and certain vapors and liquids, using activated Alumina, a solid adsorbent. Illustrated. Pittsburgh Lectrodryer Corp., Pittsburgh, Pa. (53)

Air Operated Controllers

Catalog 8900 describes the models and outstanding features of Air-o-Line, a controller with 1-150 per cent throttling range and automatic reset, and other air operated control systems which this company has developed. Brown Instrument Co., Philadelphia, Pa. (54)

Special Atmospheres in the Heat Treatment and Razing of Metals

A reprint of the above article by C. L. West, Research Engineer, is offered by The Electric Furnace Co., Salem, O. (55)

Aerocase

Booklet on this subject. Illustrations, curve charts, tables. American Cyanamid and Chemical Corp., New York, N. Y. (56)

Gas Carburizing

Operating data is contained in this booklet, SC-72, which is devoted to carburizing by the Eutectrol process. Surface Combustion Corp., Toledo, Ohio. (57)

Alloy Steel Castings

Information on corrosion resistance and technical data on Durimet and Durco Nirosta are included in a well illustrated bulletin of The Duriron Co., Inc., Dayton, O. (58)

Sonittep Products

A convenient looseleaf folder contains interesting facts on these products. Working data and applications of these products are given. Illustrated. George F. Pettinos, Inc., Philadelphia, Pa. (59)

Toncan Iron

A new folder giving complete physical properties and physical constants of this rust-resisting copper molybdenum iron has been issued by the Republic Steel Corp., Masillon, O. (60)

U S S High-Tensile Steels

Pamphlet describing high-tensile steels developed to meet the need of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (61)

Nickel and Its Alloys

List A contains many publications on the above subject. Very helpful in completing your files. International Nickel Co., Inc., New York, N. Y. (62)

Weatherproof Line Wire

Publication GEA-2103 gives information on a new wire with varnished cambric and a weatherproof braid treated with U.R.C. compound, General Electric Co., Schenectady, N. Y. (63)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (64)

Carbofrax

Leaflet illustrating Carbofrax standard brick shapes and plain tile. Tables of sizes. The Carborundum Company, Niagara Falls, N. Y. (65)

Lithorizing

Leaflet setting forth this process for making paint hold to galvanized iron. American Chemical Paint Co., Ambler, Pa. (66)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (67)

Bimetal

A simplified version of its manufacture, and the way it works is contained in this pamphlet. W. M. Chace Co., Detroit, Mich. (68)

Modern Metal Treatment

A colorful pamphlet lists the R & H chemicals available for heat-treating, electroplating and for cleaning metals. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (69)

Coreless Induction Furnace

A colorful leaflet contains an explanation of the principle of operation and advantages to be obtained from the use of the Ajax-Northrup electric furnaces. Ajax Electrothermic Corp., Trenton, N. J. (70)

Rocking Furnace

Type G-M is a small-scale indirect arc electric furnace designed for iron, steel, brass, copper and nickel alloy. The furnace is illustrated and specifications are included in a leaflet which has been prepared by the Detroit Electric Furnace Co., Detroit, Mich. (71)

Pure Carbide-Free Metals

These metals are described and applications suggested in Pamphlet No. 20. Heating Thermit Cans are also described and illustrated. Metal and Thermit Corp., New York, N. Y. (72)

Kramer Alloy News

Interesting data are found in this publication. Humor is not forgotten. H. Kramer & Co., Chicago, Ill. (73)

High Yield Casing

A colorful bulletin, No. 526, is devoted to the above which, it is claimed by the manufacturer, makes a given amount of steel render greater service without increased costs. Technical data and graphs are included. A. O. Smith Corp., Milwaukee, Wis. (74)

Atmospheric Burners

Bulletin 133-3 is concerned with the Sincro Venturi Atmospheric Burners and Immersion Burners. Illustrated. Philadelphia Drying Machinery Co., Philadelphia, Pa. (75)

Arc Welding

A book "Automatic Arc Welding by the Electronic Tornado" gives a full explanation of this system of automatic carbon arc welding for use in industries where products of relatively uniform character are produced in large quantities. Lincoln Electric Co., Cleveland, O. (76)

Refractory Cement

Bulletin No. 317, describes Q-Chrome neutral-base refractory cement which was designed for severe-service duty. Quigley Company, Inc., New York, N. Y. (77)

B & L Steel Shafting

This attractive leaflet states that you are assured of close adherence to size tolerances, concentricity and straightness, the maintenance of uniformity and freedom from imperfections in B. & L. Shafting. Bliss & Laughlin, Inc., Harvey, Ill. (78)

Duraloy

The various types of Duraloy are described and physical properties and working data given in a colorful leaflet. The Duraloy Company, Pittsburgh, Pa. (79)

Controlled Grain Anodes

Seymour Nickel Anodes are homogeneous in grain structure, according to this bulletin. The various available shapes are illustrated and some useful data are given. The Seymour Manufacturing Co., Seymour, Conn. (80)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (81)

The Jetal Process

Simple immersion in an aqueous bath for about 5 minutes colors all grades of common iron or steel a brilliant and uniform jet black. It is claimed it does not alter dimensions of articles and cannot chip, scale, peel or discolor. Alrose Chemical Co., Providence, R. I. (82)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-ray has now come to the fore as a tool of the testing laboratory. Kelley-Koett Mfg. Co., Inc., Covington, Ky. (83)

Combustion Control

Type MC for steam boilers maintains a uniform steam pressure and a correct flow of air for all rates of fuel supply according to the manufacturers. It is also adaptable to any kind of fuel, any make, type or size of boiler and to any number of boilers in a battery. Information on construction and operation are included. Diagrams. Shallcross Controls, Inc., Milwaukee, Wis. (84)

Polishing Machines

A portable model and a floor model of these new metallographic machines are described and illustrated in a pamphlet from Eberbach & Son Co., Inc., Ann Arbor, Mich.

Published by the same firm: "Electrolytic Machine" designed on the Unit Power-Contained System for effecting electrolytic deposits. (85)

Welding Rods

Hard-facing welding rods Nos. 459 and 217 are the subject of an illustrated brochure. Hard surfacing can be done with these rods, either electrically or by the oxy-acetylene process to the great majority of ferrous welding parts. American Manganese Steel Co., Chicago Heights, Ill. (86)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (87)

Acid Proof Cement

Booklet No. 1, which contains the statement that "Penchlor Acid Proof Cement is the only sodium silicate cement which is entirely resistant to steam, hot or cold water, hot or cold salt solutions of all strengths, and hot or cold acids of all strengths" gives pertinent data on the subject. Penchlor, Inc., Widener Bldg., Philadelphia, Pa. (88)

Liquitol

Bulletin A1-16-A deals with the use of Liquitol for iron and steel castings and ingots. Alpha-Lux Co., Inc., New York, N. Y. (89)

Surface Illuminator

This instrument provides an improved method for illuminating opaque or translucent specimens when examined at low magnifications. Illustrated. Bausch & Lomb Optical Co., Rochester, N. Y. (90)

Modern Gathmann Methods

A leaflet illustrates some of these methods and tells why they are vital to makers and users of steel. The Gathmann Engineering Co., Baltimore, Md. (91)

Flex-Arc Rays

Data bulletins containing information on arc welding are published by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. (92)

Heavy Duty Refractories

This hand book contains complete descriptions, applications, tables and illustrations of standard shapes. Much useful engineering data are included. Norton Company, Worcester, Mass. (93)

Industrial Furnaces

This catalog describes, illustrates and gives specifications for furnaces suitable for various applications. Mahr Manufacturing Co., Minneapolis, Minn. (94)

Heat and Corrosion Resistant Alloys Heated by Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (95)

Convected Air Tempering Furnaces Heated by Gas

Bulletin No. 40 concerns these furnaces which use the principle of mechanical convection to the maximum by incorporating in the design a patented rotary fan to drive the heated air downward with pressure and great velocity, in and around through the parts to be processed. Despatch Oven Company, Minneapolis, Minn. (96)

Elfur Electric Furnace Iron Alloys

Bulletin setting forth data on Ni-Resist corrosion and heat resistant alloys particularly suited for locomotive wearing parts, Diesel engine parts, etc. Illustrated. Cramp Brass and Iron Foundries Co., Philadelphia, Pa. (97)

New Method Annealing

Pamphlet containing data on this method. Illustrated. Power curves, comparison of annealing costs, etc. The Bellis Co., Branford, Conn. (98)

Aluminum Alloy Castings

An attractive booklet contains interesting information on selection, mixing, melting practice, molding practice for sand castings, permanent mold castings, heat treatment, etc., of these alloys. Illustrated. Arthur Seligman & Co., Inc., New York, N. Y. (99)

High Temperature Creep Values of Low Priced Alloy Still Tubes

Up-to-date circular which supersedes Circular Letter No. 2A, Nov. 1, 1933, bearing the same title. The Calorizing Co., Pittsburgh, Pa. (100)

Beryllium

Reprints of two very interesting, illustrated articles "Desulphurizing Steel with Beryllium" by W. Kroll and "Properties and Applications of Beryllium Copper" by Robert W. Carson are offered by the Beryllium Products Corp., Graybar Bldg., New York, N. Y. (101)

Floor Plate

Inland 4-Way Floor Plate is described and illustrated in a leaflet distributed by this company. Economy in matching, ready drainage and easy sweeping are some of the features discussed. Inland Steel Company, 38 So. Dearborn St., Chicago, Ill. (102)

Aluminum News-Letter

Interesting articles and items are contained in this attractively illustrated News-Letter which is published monthly by the Aluminum Company of America, Pittsburgh, Pa. (103)

Temperature Controller

Bulletin 389 is devoted to this company's new pyrometer controller Model 478 which is for temperatures up to 3000 deg. F. Mercury switches, sealed in glass, filled with an inert gas, provide clean contact with no arc, oxidation or corrosion and the main control unit and these mercury switches can be checked at any time through a glass window. The Bristol Co., Waterbury, Conn. (104)

Illium-G

Leaflets setting forth data on this product which, it is claimed, is strong, tough and hard and possesses these qualities in proportions that fit it excellently for a wide variety of uses. Illustrated. Burgess-Parr Co., Moline, Ill. (105)

Cold Drawing

Brings about advantageous changes in the physical nature of steel. These changes are shown in tables applying to a bar of S.A.E. 1020 steel before and after cold drawing. Illustrated. Union Drawn Steel Co., Massillon, O. (106)

Seamless Tubing

This very attractive, profusely illustrated catalog presents much interesting and valuable information. As most of this company's products can be classified under either mechanical tubing or pressure tubing they are grouped in this manner. Stainless steel corrosion data, miscellaneous tables and formulae and an index are included. Summerill Tubing Co., Bridgeport, Penn. (107)

Free-Cutting Phosphor Bronze-Nickel Silver

Information on outstanding characteristics and diversity of applications of these metals is contained in an illustrated leaflet. Other products of the company are also listed. The Riverside Metal Company, Riverside, N. J. (108)

K & S Pyrometer

Leaflet illustrating and describing this pyrometer whose manufacturers claim it is the most compact, accurate, lowest priced and simplest to use. Industrial Pyrometer Co., Painesville, O. (109)

Insulating Fire Brick

Looseleaf pages B-16 and B-16a contain information on G-25 brick, made entirely from first quality Missouri fire clay, which, it is claimed, develop a highly radiant surface quickly and at low temperature. A. P. Green Fire Brick Co., Mexico, Missouri. (110)

Char Carburizing Compound

The manufacturer claims that because of its low dusting loss, low shrinkage and continuously uniform activity this compound results in marked economies in the carburizing of steel. Char Products Co., Indianapolis, Ind. (111)

Thermalloy Castings

Bulletin 101 contains information on Ni-Cr castings for heat and corrosion resistance which are X-ray inspected. Electro Alloys Co., Elyria, Ohio. (112)

Industrial Gas-Fired Furnace

Users of Industrial gas-fired furnaces will be interested in the Stewart Gasifier which, the manufacturer states in a colorful leaflet, reduces fuel costs as much as 75 per cent, produces a true gas of high B.T.U. value and is easier on furnace linings. Chicago Flexible Shaft Co., Chicago, Ill. (113)

Refractories and Crucibles

An attractive book gives an abundance of information on super-refractories, high temperature cements, Tercod crucibles and Electroloys. Electro Refractories & Alloys Corp., Buffalo, N. Y. (114)

Traveling Cranes

Bulletin 195 describes and illustrates the "LH" crane for hand or electric operation. Any movement may be electrified without expensive changes in construction and without cutting down the effective lift. Working data is included. Whiting Corp., Harvey, Ill. (115)

CURRENT NEWS ITEMS

Louis Jordan to be an Assistant Secretary of the Mining Engineers

For some time there has been under consideration by the board of directors of the American Institute of Mining and Metallurgical Engineers, the appointment of an assistant secretary who should serve as secretary for the two metal divisions, the Iron and Steel and the Institute of Metals divisions.

This plan has been carried through and Louis Jordan, of the National Bureau of Standards, Washington, has been engaged. He will be located at the institute's headquarters in New York commencing February 1.

Mr. Jordan brings to his new connection a broad background and experience. His present position is senior metallurgist, chief of the section of thermal metallurgy, and assistant chief of the Bureau's Division of Metallurgy. He is peculiarly fitted to make the activities and publications of the institute of greater value to the two divisions, among the membership of which he is widely and favorably known. Members of the divisions will have the benefit of his services in the field, as well as at the headquarters.

It has been said that not the least of his qualifications for his new task is the fact that, while he may vigorously defend his view in a difference of opinion, he does so in such a way that his opponent is made a friend. His colleagues have often commented that Louis just doesn't know how to make an enemy.

Aluminum-Coated Steel Perfected

Far-reaching effects on buildings and construction, airplane and automobile design, rail equipment, and industrial machinery are foreseen as a result of a process perfected by Prof. Colin G. Fink, head of the division of electrochemistry in Columbia University, for coating steel with aluminum. Dr. Fink is holder of the Acheson Medal of the Electrochemical Society, and the Perkin Medal of the Society of Chemical Industry for his inventions in metallurgy and electrochemistry. The new material can be colored. It is malleable and ductile, and can be formed into decorative parts as well as into floors, walls, roofs, girders, and so on.

Combining the high corrosion resistance of aluminum with the tensile strength of steel, more than three times that of aluminum, the metal will find uses in fields hitherto barred to steel because it corrodes, or to aluminum because of lack of strength and endurance. Over 100,000,000 tons of iron and steel are produced in the world annually. One-fifth of this amount goes to replace iron and steel destroyed by corrosion. The new process promises to end much of this waste.

Adherent and substantially uniform, smooth, bright coatings of aluminum are obtained on steel by Prof. Fink's invention, which consists of saturating the surface of the steel with hot hydrogen gas before dipping it into a molten aluminum bath. This process insures a perfect bond between the steel base and the aluminum coat. Aluminum is very readily oxidizable in its molten state, and if oxides become interposed between the article to be coated and the aluminum, the covering will not stick.

Ferrocolumbium Now Available

The Electro Metallurgical Co., New York, announces that it is prepared to supply ferrocolumbium for the addition of columbium to 18-8 chromium-nickel steel. Addition of columbium to stainless steel practically eliminates intergranular corrosion even when the metal is exposed simultaneously to high temperatures and corrosive chemicals. Columbium-bearing stainless steel of the proper carbon and columbium contents may be used between 1000 and 1500 deg. F. without developing intergranular corrosion.

Since columbium does not burn out to a harmful degree during welding, columbium-bearing stainless steel, welded with a rod of similar composition, may be used without subsequent annealing. Weld metal and base metal are equally free from susceptibility to intergranular corrosion. Moreover, columbium does not impair the excellent general corrosion resistance of stainless steel. Ferrocolumbium provides a convenient and economical means of adding columbium to any melt.

Foundrymen's 1936 Convention and Exhibit in Detroit

Large attendance at the recent National Metal and the Machine Tool shows, that broke previous records for these events, has focused attention of manufacturers of industrial equipment on the interest that is being displayed throughout all industries in the developments and improvements in machinery, equipment, and materials. Similar interest and large attendance are anticipated at the coming Fortieth Annual A.F.A. Convention and Foundry and Allied Industries Exposition to be held in Convention Hall, Detroit, May 4 to 9, 1936.

Accordingly, plans are being made for one of the largest displays of equipment, materials and supplies for the foundry and allied industries in the history of the Association. With 166,000 sq. ft. of floor space available and excellent facilities for an unlimited operating exhibit, Convention Hall, within a few minutes of the hotel district, is an ideal location for this event.

Tentative schedule of events calls for registration, plant visitation and committee meetings on Monday, May 4, and formal opening of the exposition at 9:00 a.m., Tuesday, May 5, with final closing 4:00 p.m., Saturday, May 9.

C. C. Henning Receives Hunt Award

A distinctive honor, the Robert W. Hunt Award, has been conferred upon C. C. Henning, assistant general metallurgist of the Jones & Laughlin Steel Corp., Pittsburgh. The award, made to Mr. Henning for his paper, "Manufacture and Properties of Bessemer Steel," is an annual prize given by the American Institute of Mining and Metallurgical Engineers for what is considered to be the best technical paper of the year on the manufacture of iron and steel. The paper was presented by the author last February in New York at a meeting of the Iron and Steel Division of the Institute, of which he is a member.

Mr. Henning has been identified with Jones & Laughlin during practically his entire business experience. He joined the company in June, 1915, in the metallurgical department of the Pittsburgh Works and advanced through various capacities to his present position. He is a member of the American Society for Testing Materials and the American Society for Metals.

Additions to Battelle's Staff

Battelle Memorial Institute, Columbus, Ohio, announces the appointment of Dr. Iver Igelsrud to the technical staff. Dr. Igelsrud is a graduate of the University of Washington and has specialized for some years in the study of industrial water supplies. He has been assigned to the division of applied chemistry at Battelle.

Alfred Boyles, for ten years metallurgist with the Tennessee Coal, Iron & Railroad Co., has been assigned to the Institute's staff working on problems for the iron and steel industry, and Wilbur H. Bachman, a graduate of Ohio State University, has been assigned to the division of physical metallurgy.

Joel C. Carpenter, who, since his graduation from Case School of Applied Science, Cleveland, in 1929, has been engaged in non-ferrous metallurgical research, principally in the plants of the Chase Brass & Copper Co., has been assigned to the division of process metallurgy.

Dr. Herty, Jr., Receives the Clamer Medal

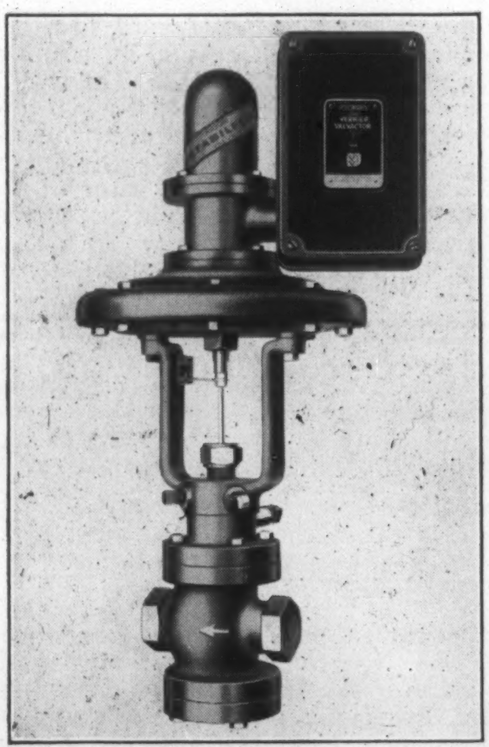
The Technical Society of Philadelphia, member of the National Association of German-American Technologists, awarded the Francis J. Clamer Medal to Dr. C. H. Herty, Jr., prominent research metallurgist of the Bethlehem Steel Corp., Bethlehem, Pa., on Saturday evening, Dec. 7, 1935, at the Hall of the German Club, Philadelphia. The Francis J. Clamer Medal is a bequest by the society's late member, Francis J. Clamer, awarded annually by the society for the most meritorious achievement in the field of metallurgy.

NEW EQUIPMENT AND MATERIALS

Foxboro Vernier Valvactor

A new accessory for air-operated control valves, the "Vernier Valvactor," developed to eliminate valve sticking and to assure hair-line valve positioning, is the latest addition to the complete line of control instruments manufactured and sold by The Foxboro Co., Foxboro, Mass. This device enables throttling type air-operated control instruments to make small gradual adjustments of the control valve position regardless of friction or hysteresis. It is claimed that the air from the control instrument need change as little as ½ in. of water to cause a corrective positioning of the valve and force the stem to take a position within 1/1000th in. of the previous one.

In the great majority of installations, Foxboro control valves will respond proportionately to small changes in air pressure without this device. This is especially true of "Stabilflo" valves because their unique diaphragm motor design gives more power, size for size, than any other motor available. The Vernier Valvactor guarantees exact valve responses where the valve stem packing must be very tight to prevent leakage; where the fluids are viscous or contain solids; and friction is otherwise unavoidable or wherever there is danger of valve friction developing. In brief, the Vernier Valvactor gives an added assurance that the valve positively will not lock itself in one position, and should be used wherever this assurance is necessary.



The use of air relay in the Vernier Valvactor assures fast and positive operation because an ample supply of air is always available. The unit is mounted in a cast aluminum case, is completely weatherproof, and may be exposed to the elements. The case is also available in gas-tight construction, properly vented so that the Vernier Valvactor may also be operated in doors on gas supply with the vent piped to a safe spilling point.

The Vernier Valvactor can be attached directly to the spring housing of all sizes of Stabilflo valves. For needle valves and valves without the Stabilflo type of motor, the Vernier Valvactor is mounted on the side of the motor supports. It can be installed very easily to valves in the field, with but little interruption to service.

Purolator Rids Sandblasting of Health Peril

Patents have been allowed to Motor Improvements, Inc., Newark, N. J., developer of air filters for numerous industrial purposes, covering an improved "Purolator Air Separator" which sandblast operators have told this company will result in a better finished product and a great reduction in the cost of this method of metal finishing. Tests in the company's sandblasting chamber, according to officers of Motor Improvements, Inc., have confirmed these statements.

Such is the cutting power of sand shot by compressed air from sandblasting guns that sandblasting has usually been performed in a closed metal-lined room. One purpose has been to conserve the sand for further use; another, to keep it from sifting into other parts of the plant with injurious effect on all machinery. The new Purolator air separator absorbs fumes and removes as well the oil and water moisture from the air so that pure breathable air is delivered to the operator's mask.

This new separator has a filtering element of brass and a special alloy of bronze enclosed in a metal case. The element surface is made of a special alloy bronze ribbon, wedge-shaped in cross sections, and having rises 0.0005 in. high placed at intervals of 1/8 in. on one side of this ribbon. The other side is smooth. This ribbon is wound in a spiral around a brass cylinder having fluted sides in such a way that the ribbon, standing on edge and being held apart by the rises forms a series of slots each with a width of 0.0005 in. and a length of approximately 1/8 in.

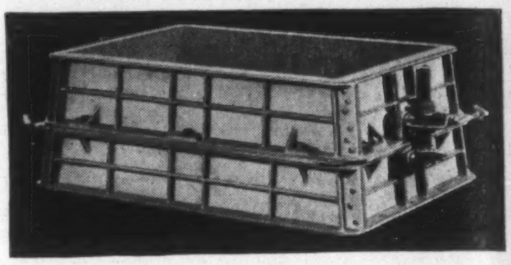
Compressed air enters the separator case, striking the inside walls of the case and the external surface of the filtering element. These parts act as baffles and some oil and water is at once removed and drops to the sump in the bottom of the container. The greater part of the separation takes place, however, while the air is passing through the filtering slots in the filtering element. There are 26,766 slots whose sharp edges shear from the tiny stream passing through it minute and even microscopical drops of oil and water. Such small amount as is pushed through the slots adheres to the metal because of surface tension and attraction for the metal and falls to the sump.

The space within the body cylinder which is left open in purolator's design only to produce dry air is filled in this case with approximately ½ lb. of activated carbon and a 60-mesh screen and wool cap is placed at the top of this cylinder to prevent the entrance into the air line of particles of this carbon. It is this carbon which absorbs the dangerous fumes in the air. Its capacity is extremely large for its physical size and it needs replacement only about once in each 6 mos. The separator is so arranged that the filtering unit may be removed for such refilling as well as for cleansing.

Featherweight Foundry Flask

An American featherweight flask is now being manufactured by the American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Ind. This flask has four outstanding features, according to the manufacturers: (1) Light weight, (2) strengthened corner construction, (3) especially designed pin pad, (4) the production increasing sand strip.

This featherweight flask, made of magnesium alloy, over 30 per cent lighter than aluminum, is lighter than many snap flasks. Although lighter in weight, the American flask, it is claimed, has greater tensile and bending strength than aluminum. Extreme lightness of weight and great strength are two of the major elements desired in flask equipment.



The new corner design of riveted construction bestows great strength on the American flask. There is no welding or pouring of corners, thus eliminating all possibilities of distortion of the flask becoming out of square. This corner design, with ribbed construction of the side walls, provides a flask that will give long life and continued accuracy.

The patented pin pad permits the use of any standard pin. Pins which are now standard can be supplied on the new flask. Molding machines, match plates, etc., do not have to be altered for a special pin. The flask is easily adaptable to pins in use by the individual foundry. With a maximum taper of 5 deg., the "Featherweight Flask" allows for easy stripping. The exclusive sand strip design enables this maximum taper. It protrudes an equal distance completely around the the flask providing a firm support for the sand in the cope. The sand strip is cadmium plated, eliminating rusting and sticking.

New Power Operated Turntable

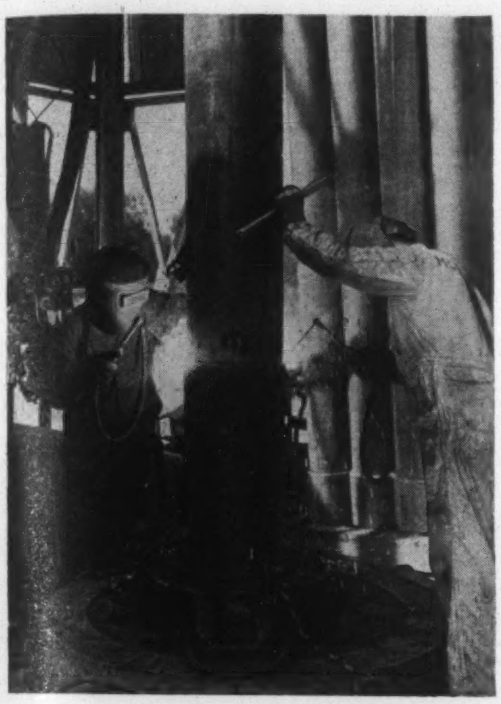
A new Westinghouse equipped electrically operated 7-ft. dia. turn-table suitable for revolving 6-ton coils of strip steel prior to pickling, is announced by the Mathews Conveyor Co., Ellwood City, Pa.

The unit is driven by a 5-hp. 1200-r.p.m. 3-phase, 60-cycle, 220-volt motor coupled to a vertical speed reducer and spur gears. Its purpose is to receive from a straight line of conveyers 12,000-lb. coils of strip steel, which are placed on the conveyer from coil storage at random. The turntable serves to place the coils of steel with their fish tails (or loose ends) in a proper position to enter the continuous pickler. Since the coils are conveyed on their side, core axis horizontal, a troughed section of heavy duty conveyer is used to handle this circular shape. The individual rollers in the conveyer section are ball bearing, grease-packed type fitted with grease fittings for periodical lubrication. The rollers are 3⅝ in. diameter, each having a continuous load rating of 2000 lbs.

High Yield Casing for the Oil Industry

Shipments of "High Yield Casing," recently introduced by the A. O. Smith Corp., Milwaukee, have now been made to a number of oil fields in California, Texas and New Mexico. This product, entirely new in conception, promises to be as revolutionary as "Smithwelded Cracking Stills" were for oil refining and as "Smithwelded Line Pipe" was for natural gas lines.

The Smith "High Yield Casing" offers new advantages to the oil industry in the following three ways: 1. Permits the use of a lighter weight casing for a specified depth while maintaining the present safety factor. This results in considerable saving in both steel and freight costs; 2. materially increases the safety factor at any specified depth without increasing the weight. This offers added insurance at no extra cost; 3. allows greater setting depths while maintaining the present safety factor. This meets the demand brought about by the inevitable trend to still deeper wells.



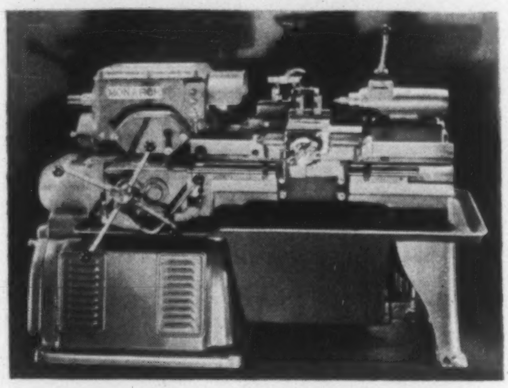
Introductory strings of high yield casing have already been set by some of the larger producing companies, with excellent results in every instance. The reception by the industry has been fine and the new casing promises to allow the tapping of deeper oil sands with a higher safety factor than was heretofore possible. The illustration shows high yield casing in the field and welding of slip joint casing on a California Derrick Floor. This casing is also supplied threaded and coupled.

A 12-In. Type "T" Semi-Automatic Manufacturing Lathe

Recently, the Monarch Machine Tool Co., Sidney, Ohio, announced a new addition to its line of manufacturing type lathes—the 12 in. type "T" Double Carriage Semi-Automatic Lathe. It was exhibited for the first time at the recent Cleveland Machine Tool Show, where it attracted widespread attention.

This new semi-automatic manufacturing lathe is designed to handle the smaller classes of production jobs where a quick, convenient hand return to the tool slide is desirable. This lathe will accommodate the main drive motor up to 10 hp. It is equipped with automatic length feed stop, and so arranged that a very quick tool set-up, for either single or multiple tool jobs, can be made. Extremely rigid in construction, this new lathe is equipped with anti-friction bearings throughout, and it is interesting to note that all the steel parts are heat treated and hardened. This new lathe will operate at spindle speeds as high as 2000 r.p.m. in order to take advantage of the new cemented carbide turning tools.

This new lathe is very simple in design and can be furnished with special tooling to perform a wide variety of single or multiple tooled manufacturing operations. It can be equipped with front carriage or with both front carriage and rear facing carriage. The rear facing carriage can be applied to the lathe after shipment from the factory.



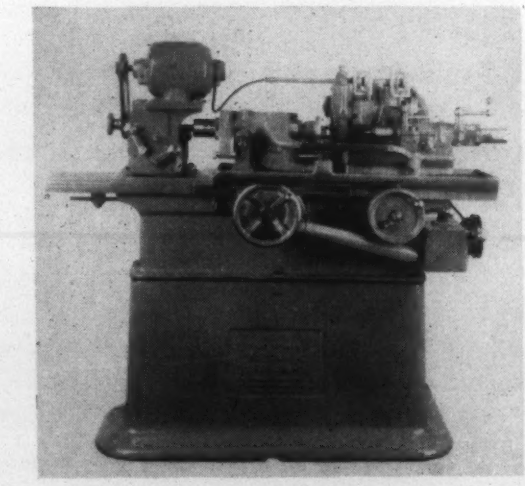
The motor is mounted inside the cabinet leg, drive by multiple V belt. Convenient pick-off gears are provided to change spindle speeds and to change feeds on both the front and rear carriage.

Swing over bed ways is 12½ in., while the swing over the carriages is 7 in. Distance between centers can be 18 in. base length, 30 and 42 in. Net weight of the base length machines is 3400 lbs. Any desired range of spindle speeds or feeds can be provided.

High Speed Piston Grinder

An extremely fast, heavy-duty machine for turning and grinding pistons has just been announced by Van Norman Machine Tool Co., Springfield, Mass. The new machine is described as "No. 101 Automatic Piston Grinder." It finishes pistons of both the straight and cam type. A shift of a lever converts the machine from straight to cam grinding.

According to the manufacturer, the high speed of the new machine comes not only from the increased spindle speeds and wheel feeds, but also from the machine's extreme simplicity and ease of operation. It is stated that an operator can set up the machine more rapidly and also handle pistons with less loss of time for chucking. A number of speeds are available at the wheel and work heads.



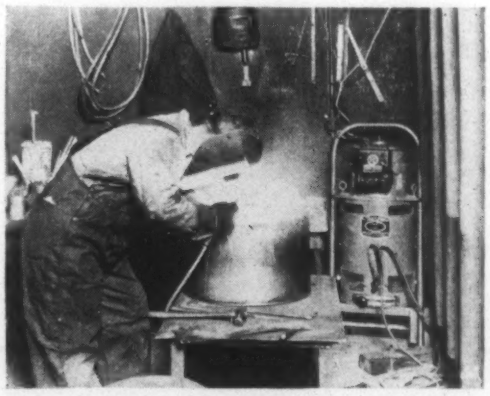
The machine is of heavy construction, built throughout to machine tool standards. All ways are hand scraped, bearings are of the anti-friction type, designed for easy and accurate take up for wear.

Low Amperage Welding in Air-Conditioning Field

As an example of the way the air-conditioning industry is girding itself to meet the demands of increased volumes, comes the experience of one large company in adopting the metallic arc welding process in the fabrication of their product.

The L. J. Mueller Furnace Co., Milwaukee, pioneers in the manufacture of household, theatre, hotel and office "Climator" conditioning units have adapted low amperage electric welding to their own manufacturing problem. With special attention to proper positioning of the work to obtain the greatest efficiency in welding time, the Mueller company has demonstrated the cost savings possible in the welding of the light "gage" metals. One 50-amp. welder working 24 hrs. a day, 5 days a week, deposits 156 in. of coated rod on each of 150 air-conditioning units. With the exception of one 36-in. weld, all beads average 3 and 4 in. in length and are scattered generally throughout the 18 gage, 4-ft.-sq. housing tank and blower fan enclosure.

Cost records made with the P. & H.-Hansen welder for an average day's production reveal that the electrical power consumption is only 3.6 kw, at a cost of 87c. The 3½ lbs. of high quality welding electrodes deposited during this time and including 25 per cent loss for waste ends, cost 63c. In other words, the total cost for a full 8-hr. production period for both electrical current and welding materials is only $1.50—a decided reduction in cost. At the same time, there is a marked increase in production speed over old methods of fabrication.



Fatigue Testing Machines of High Capacity

Alfred J. Amsler & Co. have recently developed a specially rigid type of hydraulic, universal testing machines for both, static and dynamic tests in tension, compression, and transverse, for loads up to 60,000 lb., 100,000 lb., and 200,000 lb.

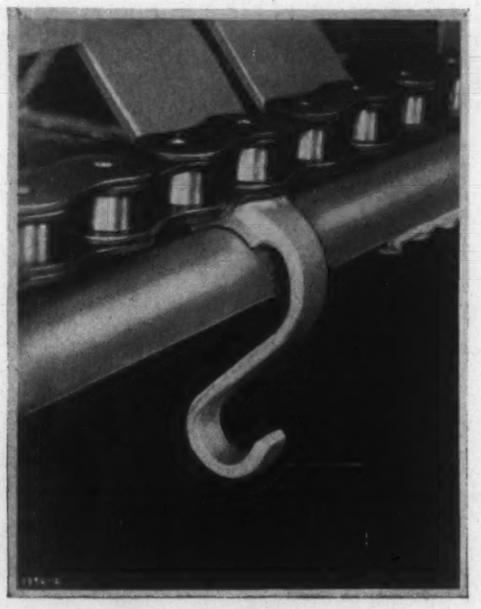
These machines are constructed with four columns. A hydraulic pulsator of large capacity is furnished with these machines, so that deformations of considerable magnitude, required particularly in transverse fatigue tests, can be readily produced. For standard static tests, these machines are provided with the well-known Amsler pendulum dynamometer. Rapidly repeated stress tests can be performed up to the full capacity of the machines, speeds being adjustable up to 500 stress-cycles per minute. These machines represent the only means available for fatigue tests of full-size test-bars and other large sections, such as welded sections, etc. It is handled by Herman A. Holz, 167 East 33rd St., New York.

Semi-Automatic Plating Machine

The Udylite Co., Detroit, manufacturers of polishing and plating supplies and equipment, announces the development of a new semi-automatic plating machine. This machine is said to offer the advantages of better plating results, closer production regulation and lower plating costs. Construction of the new unit includes a number of improvements in design which contribute to lower operating cost and a minimum of maintenance expense.

Better plating results and a marked reduction of rejects are effected, it is claimed, because each piece being plated is subjected to identical plating conditions, i.e., plating time, current density, etc. Therefore, the machine can be set and work plated to the desired thickness specifications is produced.

Production can be regulated within very close limits. The work racks are hung on the chain conveyor and are carried away from and brought to the operator at a definite rate of speed. This results in a continuous uninterrupted flow of production which in turn means a saving in labor. Any desired chain speed between 1 and 4 ft. per min. is obtainable.



In addition to money savings through reduction of rejects and closer production regulation, the "Udylite Semi-Automatic" effects still further savings in that one man can do the work of two or possibly three with several still tanks.

In the construction of the Udylite semi-automatic, attention has been paid to simplicity, compactness and durability. Design features include strong structural steel chassis; new, simplified chain-hook combination; alloy steel chain with breaking strength exceeding 5 tons; cut tooth drive sprockets—equipped throughout with ball and roller bearings which need lubrication but once every six months; hooks designed for heavy loads and high current carrying capacity.

The Udylite semi-automatic is made in a wide variety of sizes to conform to the individual plating problem.

Gas Firing Improves Tool Steels

An improvement in the quality of the finished product, coupled with a decreased scale loss, has followed the installation of the first completely controlled gas-fired furnaces for forging of tool steels at the Chicago Heights plant of the Columbia Tool Steel Co.

Following the first installation, three additional furnaces have been converted to gas firing, and complete conversion of the plant to the use of gas is in prospect as a result of the successful operation of these furnaces. The installations were made by the Mahr Mfg. Co., Minneapolis, under the direction of Robert G. Guthrie, chief metallurgist for The Peoples Gas Light & Coke Co., Chicago, in whose laboratory the preliminary research leading to the installation was conducted.

The success of the Columbia installation is based upon a new conception of gas, involving recognition of the fact that gas is a valuable metallurgical chemical in addition to being a source of heat. Mr. Guthrie and his associate, Dr. Oscar J. Wilbor, have been engaged in research of this nature for a number of years, and the new installation is practical proof of the value of their research.

The Columbia installation now involves the conversion to gas firing of four furnaces with hearths up to 16 ft. in length and 7 ft. in depth, with loading capacities up to 20,000 lbs. per charge. The insides of the furnaces were re-designed and re-bricked in order to give satisfactory dimensions and conditions for gas firing. Flue vents were installed in place of stacks, and fireboxes were bricked over.

Each furnace was equipped with three Mahr low-pressure sealed in burners of special design, each burner having a capacity of 2,100 cu. ft. of 1,000 B.t.u. natural gas per hour mounted in an especially constructed and proportioned combustion chamber. Air is supplied by individual blowers on each furnace.

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CHAPMANIZING
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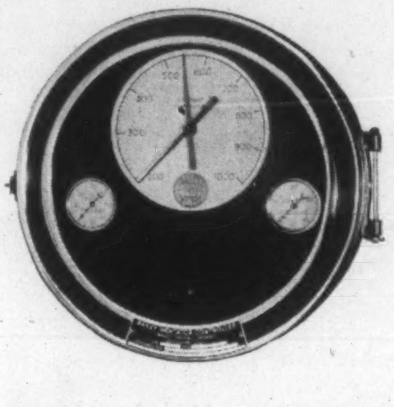
Indian Orchard, Massachusetts

Air-Operated Indicator-Controller

For pressure and temperature control applications not requiring a record of the factor under control, the Bailey Meter Co., Cleveland, has developed an indicator-controller which may operate either a diaphragm motor valve or an air-operated control drive. This controller is housed in a 13 in. diameter round casing and may be mounted either flush on a panel or on a wall or column.



It incorporates an indicating pointer and scale graduated to measure the factor under control. A second pointer indicates the standard for which the controller is set so that the two pointers coincide when the controller is in operation. The standard setting may be changed to any desired point by turning a knurled knob located under the indicating dial. An adjustment is also provided whereby the sensitivity or "control range" may be varied from 1 to 1000 per cent of the measuring range.

Inside the casing, a Bourdon tube type pressure spring actuates both the indicating pointer and a free floating air pilot valve. Inlet and outlet air pressures to this pilot are indicated by small gages on either side of the main indicating dial and connections for air supply and control pressure are made through the rear of the casing with ¼-in. o.d. copper tubing.

"Markal," a Paint Which Solves Marking Difficulties

Real paint in stick form which is easily applied to any wet or dry surface, and which will not run when applied to hot metals, is the newest development for marking products and materials.

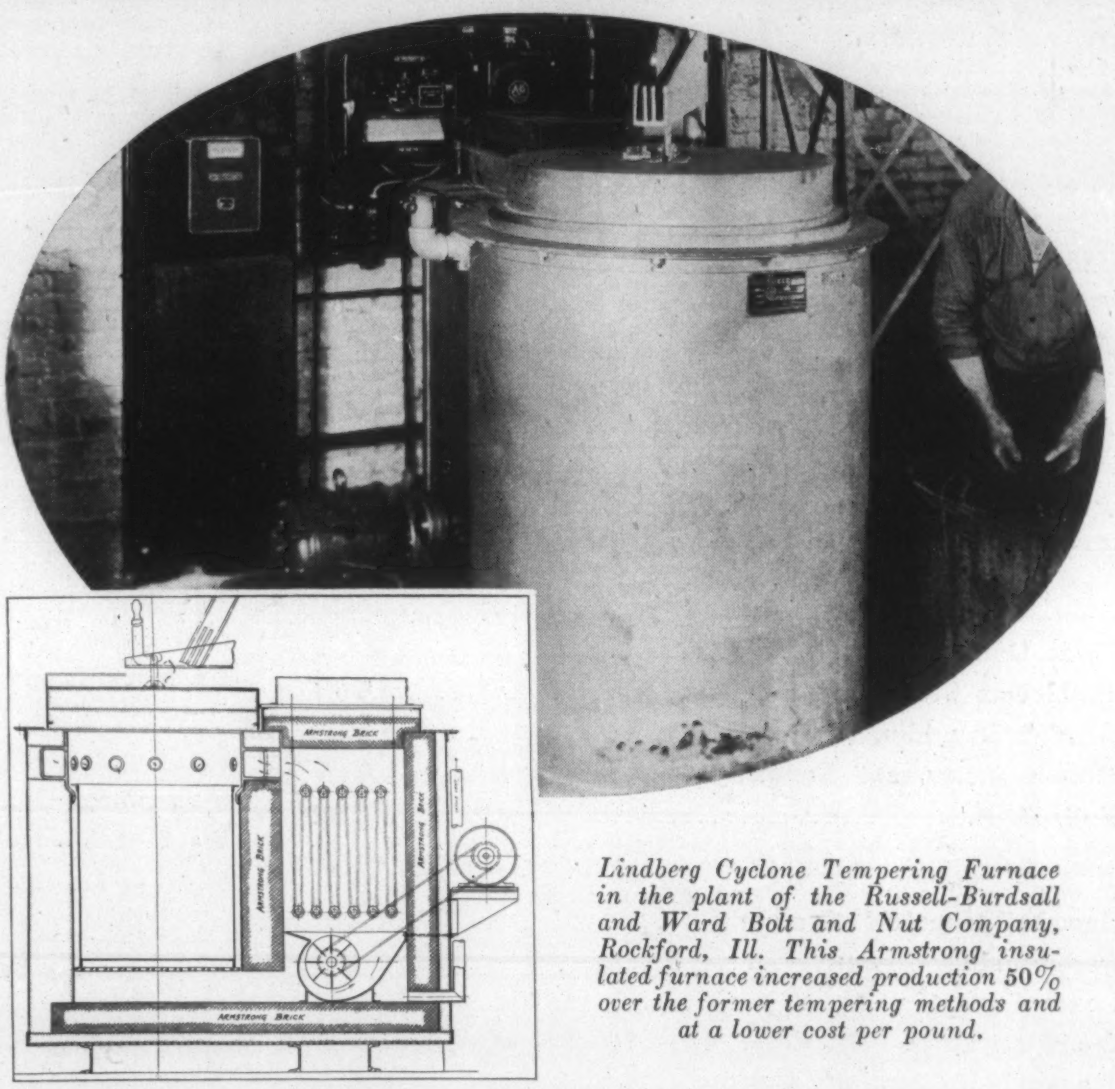
"Markal" is the name of this new stick paint. It is claimed that anyone who can write can now place permanent markings on any hard-surface material. It is actual paint, not chalk or crayon, and can be carried around in the pocket as easily as a pencil. It is made in two types—for cold marking, and for hot marking.

Markal for cold marking is used for marking all metals including structural steel, steel sheets, galvanized iron, etc. It dries and remains as permanent as any other high quality paint. Markal for hot markings is used with signal success on steel shapes, forgings, castings, pipes, billets, etc. It marks clearly and permanently at any temperature from 300 to 1200 deg. F. It does not run or flow while hot, or peel off after cooling. Markal hot markings have remained as clear-cut at the end of six months as the day they were made.

Markal for cold marking is furnished in black, white, red, yellow and blue sticks, and for hot marking in white and yellow. It is marketed by Helmer & Staley, 2323 So. Parkway, Chicago.

This New Furnace Uses Armstrong's Brick to Assure

EFFICIENCY..SPEED..UNIFORMITY



Lindberg Cyclone Tempering Furnace in the plant of the Russell-Burdsall and Ward Bolt and Nut Company, Rockford, Ill. This Armstrong insulated furnace increased production 50% over the former tempering methods and at a lower cost per pound.

THE new Cyclone Furnace, built by the Lindberg Engineering Co., of Chicago, is setting performance records for air tempering furnaces with its faster heating, rapid quality production. Large quantities of air are forced to every part of the densest charge by a blower type fan. The furnace's rugged construction eliminates production interruptions.

Armstrong's EF-22 Insulating Fire Brick and Armstrong's A-25 Insulating Brick help to make these achievements possible. These brick make possible thinner walls with consequent quicker heating, a sharper furnace and more accurate temperature control. Additional important advantages offered by these brick are lower fuel costs, more efficient production, and more uniform quality.

Armstrong's EF-22 and EF-26 Brick are light-weight insulating fire brick for use up to 2200° F. and 2600° F. respectively. N-16 and N-20 Insulating Brick are recommended for temperatures up to 1600° F. and 2000° F. respectively behind the refractory. Armstrong's A-25 Insulating Brick will withstand temperatures up to 2500° F. For complete information on all of Armstrong's high temperature products, write Armstrong Cork Products Co., Building Materials Division, 982 Concord Street, Lancaster, Pa.

Armstrong's

HIGH TEMPERATURE INSULATION

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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Detailed Statistical Microscopic Analyses of Ore and Mill Products of the Utah Copper Co. R. E. Head, A. L. Crawford, F. E. Thackwell & Glen Burgener. *United States Bureau of Mines, Report of Investigations* No. 3288, Sept. 1935, 93 pages. The Cu in the feed to the Arthur mill is divided as follows: chalcopyrite 59.09, chalcocite 15.84, covellite 11.78, bornite 8.12, and malachite 5.17%. Between 62 and 65% of the total Cu recovered occurs in the size range —200 + 800 mesh and maximum efficiency of concentration occurs in this range. Between 78 and 82% of the total Cu lost occurs at +200 mesh and —800 mesh; more than 1/3 of all the Cu lost is in the -6μ slime. In the Arthur mill Cu recovery at —200+800 mesh was 97.4%; at -6μ Cu recovery was 72%. Mineral composition of the feed and of the concentrate was, respectively, pyrite 2.036, 13.60; chalcopyrite 1.688, 57.32; bornite 0.126, 4.25; chalcocite 0.195, 6.58; covellite 0.174, 5.95; and malachite 0.088, 0.74%. Total recoveries of various minerals at the Arthur mill were chalcopyrite 96.09, covellite 95.98, chalcocite 95.39, bornite 93.65, malachite 23.87, pyrite 18.86 and miscellaneous 0.33%. Similar data are given for the Magna mill.
AHE (1)

■ 1a. Crushing, Grinding & Plant Handling ■

Recent Development of the Hardinge-Hadsel Mill. Harlowe Hardinge. *Mining & Metallurgy,* Vol. 16, July 1935, pages 299-300. Describes recent improvements made on the older Hadsel crushing and grinding mill. Inefficiency of the old mill caused by cementing of sulphides in bottom of tank causing erosion of outside scoop and a "critical size" built up inside of mill with certain type of ore, lowered capacity of mill. Outside tank was eliminated and tests with 8 different types of ores gave very good results. Frictional wear was reduced and definite control of classification obtained.
VSP (1a)

■ 1c. Flotation ■

Some Effects of Diluting a Flotation Pulp. Oliver C. Ralston & Clarence R. King. *Mining & Metallurgy,* Vol. 16, Aug. 1935, pages 332-333. Gives results of research into the possibilities of concentrating United Verde massive sulphide Cu-Zn-Fe ores by flotation. Results show: (1) In cleaning reground rougher Zn concentrate made from a complex massive sulphide ore, if dilution of cleaner feed is maintained between 20 and 30% solids, recovery is maximum, tailing cleaner and concentrate of minimum grade; (2) If dilution cleaner circuit is maintained below 15% or above 45% solids, grade of concentrate approaches a maximum, but recovery falls off; (3) Greater recovery with a slightly higher grade of concentrate may be made by operating cleaner circuit at dilution of 40 to 50% solids than when operating at usual 5 to 10% solids; (4) Laboratory flotation test indicates that above noted effects of circuit dilution are manifested to a lesser degree in roughing circuit; and (5) Same conclusion as in (3) is reached in Cu cleaning circuits.
VSP (1c)

Gold-Bearing Copper Ore from Gogama, in the Township of Chester, in the Three Duck Area, Sudbury Mining District, Ont. W. B. Timm *et al.* *Canada Department of Mines, Mines Branch Report* No. 744, 1934, pages 91-93. Flotation of an ore assaying Cu 2.48%, Au 0.06 oz. and Ag 1.06 oz./ton resulted in recovery of 85% of the Au, 90% of the Ag and 95% of the Cu in a conc. assaying Au 0.48 oz. and Ag 8.8 oz./ton and Cu 23%. A higher grade ore gave poorer results.
AHE (1c)

Alena's Output Chiefly Gold—Both Lode and Placer. H. L. Tedrow. *Engineering & Mining Journal,* Vol. 136, Aug. 1935, page 405. Local ores are amenable to flotation. Pine oil and xanthate are the common reagents with fuel oil use to depress the shale present. Concentration ratio is from 6 to 12 to 1 and 90% extraction is obtained.
WHB (1c)

The Story of the Bubble. G. A. Gillies. *Canadian Mining & Metallurgical Bulletin* No. 279, July 1935, pages 349-354. A discussion of the fundamentals of flotation.
AHE (1c)

Floatability of Lead and Silver Jarosites. R. E. Head & F. E. Thackwell. *Progress Report—Metallurgical Division. 11. Studies on the Recovery of Gold and Silver, United States Bureau of Mines, Report of Investigations* No. 3275, June 1935, pages 55-65. Plumbojarosite and argentojarosite occur more commonly than is generally realized. Jarosites are lethargic in their response to the reagents ordinarily used in oxide ore flotation. In general, plumbojarosite floats best in a neutral or slightly acidic circuit. The mineral does not sulphidize under customary treatment. Na_2S blackens plumbojarosite after 3 hours, but the result is detrimental to flotation. It does not sulphidize with H_2S, although it is blackened after 1 hour of treatment, due to S at boundaries of groups of platy crystals. This caused depression with all subsequent collectors except oleic acid. Under some conditions plumbojarosite floated readily with sulphuretted pine oil. It is floated very readily by both the saturated and unsaturated series of the fatty acids. Increasing the temperature of the pulp increases recovery with the fatty acids of higher melting point. Slime sizes consume over 10 fold the amounts of fatty acids necessary to obtain corresponding recovery on minus 200 plus 560-mesh plumbojarosite. The fatty acids are not selective enough in their flotation action. No effective separation is made from calcite. By close regulation of deflocculating agents a fair degree of separation can be made from quartz. Higher xanthates are good collectors for plumbojarosite in the relatively fine sizes; the treatment of true slimes presents a difficult problem.
AHE (1c)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

■ 2a. Non-Ferrous ■

Recent Advances and the Economic Situation of Non-ferrous Metals. Nickel (Les récents progrès et la situation économique des métallurgies autres que la sidérurgie. Le nickel). Léon Guillet. *Revue de Métallurgie,* Vol. 32, Aug. 1935, pages 321-341. New Caledonian Ni ores contain the mineral as a double Mg-Ni silicate. It is melted in shaft furnaces with gypsum to form NiS. The process is expensive because the large proportion of Mg contained in the ore requires about 40% of the weight of the charge of coke. At present, local coke made of Australian fines is used. The matte produced is blown in basic converters to yield 77-78% NiS which is shipped to Europe for refining. Roasting is usually conducted in 2 stages. The use of Maletra furnace gives a 5-6% S content during the first roasting which is eliminated by grinding and a second roasting. The same furnace is used for both. The oxide is pressed in solid bodies and reduced with C in muffle furnaces, giving 99.4% min. Ni metal. In the plant of The International Nickel Company Ni ore is smelted in an electric arc furnace with 2-3% coke or charcoal. The electrodes are kept well away from the slag or metal to prevent carburization. Ferronickel is produced. An electrolytic process for refining using Fe-Ni anodes is used. Cathodes made of Ni wire are surrounded by bags acting as diaphragms. Pure $NiCl_2$ solution is pumped in these bags keeping the outside solution away by hydrostatic pressure. The solution contaminates by dissolving anodes only after leaving the diaphragm. This solution is continually removed from tanks, passed over basic Ni carbonate or alkali carbonate to precipitate Fe and is returned in the diaphragms. The metal produced analyzes 99.9% Ni. Operations used for Ni production at Sudbury, Copper Cliff, Coniston, Falconbridge, Port Colborne, Clydach, Christianssands are described. Economic situation and the deposits available are given.
JDG (2a)

Concentrating Gold in Copper Converting. G. M. Lee. *Mining & Metallurgy,* Vol. 16, Sept. 1935, pages 383-384. Several improvements have been made in Granby smelting practice the past few years; most novel and outstanding was the development of a process for concentrating Au and small amount of Ag in a portion of blister Cu produced. Process consists of charging both converters with matte from settler and starting slagging blow. As additional matte is available it is added to first converter while second converter continues blowing without additions of matte until white metal is produced. As No. 2 is being blown to blister; matte in No. 1 is carried to white metal stage and addition of matte is regulated so this charge is high at same time as No. 2 is finished. After skimming, white metal is transferred to No. 2. Blowing for 5 min. charge is settled and white metal poured off and returned to No. 1 where it is blown to blister Cu and cast. Cu in No. 2 can be refinished, blown and cast. It will contain 95-98% of the Au and 55-60% of the Ag, ratio of concentration will be 3 to 1. To build up ratio of concentration fresh matte is added. Includes a table showing results obtained in converter experiment.
VSP (2a)

Losses in Cupellation—Reduction by New Type of Cupel. J. T. King. *Chemical Engineering & Mining Review,* Vol. 27, Aug. 8, 1935, page 378. A cupel 1¼" in diam. gave a Ag loss of 1.65% as compared with 2.13% for the standard, with a cupelling time of 36 min.—7 min. longer than the standard. Use of 70% cement and 30% bone ash gave as low a loss as those of all bone ash. The results of a lengthy investigation are summarized. The design of the cupel is shown.
WHB (2a)

Noble Metals (Edelmetalle). F. Michel. *Chemiker-Zeitung,* Vol. 59, Oct. 2, 1935, pages 803-806. The preparation and uses of Au, Ag, Pt, and Pt group metals are described.
CEM (2a)

The Electrical System of the Hudson Bay Mining and Smelting Company, Limited. G. F. Cross. *Transactions Canadian Institute Mining & Metallurgy,* 1935 (in *Canadian Mining & Metallurgical Bulletin* No. 283, Nov.) pages 489-510. The distribution system in the Flin Flon metallurgical plants including the electrolytic Zn plant and Cottrell systems.
AHE (2a)

■ 2b. Ferrous ■

Electro-magnetic Equipment for the Metal Trades. W. E. Box. *Metallurgia,* Vol. 12, Oct. 1935, pages 177-180. Describes equipment used in ore dressing, lifting, sorting and for other purposes.
JLG (2b)

Further Determinations of the External Heat Loss of Blast Furnaces. D. F. Marshall. *Iron & Steel Industry,* Vol. 8, May 1935, pages 298-302, 304. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 388R/5.
CEJ (2b)

Notes on the Development of the Iron Blast Furnace. A. J. Boynton & S. P. Kinney. *Metals Technology,* Oct. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 652, 21 pages. Progress in blast-furnace engineering during the past 5 years has been unimportant except for the application of electric precipitation for gas cleaning. Improvements in certain details and in materials of construction, such as high-conductivity Cu for tuyeres, are mentioned. Difficulties in operation result from disproportion between diameter of the present-day furnace at the bosh and at the stock line. It is proposed to remedy this disproportion and to restore relations as they formerly existed by a new method of filling. This method requires a double bell arranged to discharge towards the periphery or towards the center of the furnace. Coke is classified into 2 sizes, the finer going to the center and the coarser to the periphery along with the ore. By this means the resistance of the center of the furnace is increased, and the stockline diameter may be greatly increased. The modification should result in improved fuel economy and regularity of operation, and also to a greatly reduced production of flue dust.
JLG (2b)

3. MELTING, REFINING AND CASTING

German Progress in Automobile Castings (Deutsche Fortschritte im Automobilgussstücken). W. A. Geisler. *Giesserei,* Vol. 22, Sept. 13, 1935, pages 460-466; *Foundry Trade Journal,* Vol. 53, Aug. 8, 1935, pages 97-101, 104. German exchange paper read before the Annual meeting of the Institute of British Foundrymen, 1935. Alloys, molding and casting methods are reviewed. 24 references. Ha + AIK (3)

Judging Molding Sands According to Grain Distribution (Verfahren zur Beurteilung von Formsanden nach der Korngrössenverteilung). R. von Halasz. *Giesserei,* Vol. 22, Sept. 13, 1935, pages 466-468. It is proposed to classify molding sands not by the usual determination of the ratio of percentage of each grain size to the average grain size but by the percentage of each sifted part from 0 to k mm. to the diam. k of the hole of the sieve. Ha (3)

Overcome Defects Through Study. W. M. Ball, Jr. *Foundry,* Vol. 63, July 1935, pages 32-33, 60. From a paper read before the Pittsburgh Foundrymen's Association. Lists types of defects caused by porosity, their causes and remedies. Overcoming defects in castings may be accomplished by the industrial conference method of education which is a scientific plan for blending practical experiences with science and theory. Author claims that if this method of procedure is used many troublesome problems can be solved. VSP (3)

Castings. W. Machin & M. C. Oldham. *Foundry Trade Journal,* Vol. 53, Aug. 15, 1935, pages 115-117; Aug. 22, 1935, pages 135-140; Aug. 29, 1935, pages 148-153; Sept. 5, 1935, pages 164-170; Sept. 19, 1935, pages 209-212; Oct. 10, 1935, pages 275-278, 280; Oct. 24, 1935, pages 316-318. Lengthy paper read before the Annual meeting of the Institute of British Foundrymen, 1935. Feeding iron and non-ferrous castings, Lanz process for making pearlitic cast iron, dimensional and weight changes on repeated heat tests of ordinary engineering iron, silal and nicrosilal alloys, contraction allowances for brass, Mn bronze, steel and Fe, coremaking, mold facing, causes of blowholes, cold shuts, scabs, repairing steel castings by welding and many other important foundry problems are discussed by the authors. It is emphasized how important it is that the hottest metal should be in the feeders at the finish of the casting operation and that ample provision must be made to ease the castings quickly. AIK (3)

Spongy Spot and the Léonard Effect. M. Kagan. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, pages 224-226. Of all defects known to the foundry, that known as "spongy spot" is the most common and most serious. This applies equally to the iron and non-ferrous foundry. Tests made by forcing coloring matter through Fe have shown that it is necessary for pressures to reach 200 to 800 atm. before irons can be considered porous. Spongy spots, however, are always synonymous with unsoundness and porosity. It seems that the main causes of spongy spots are the gases brought into the metal either by the Léonard effect, that is to say, by a local and excessive heating of protruding portions of sand, or by the tendency of the core gases to penetrate in the liquid metal as a result of certain pressures. The reactions which can be presumed to take place in the mold because of the action of metal on sand are as follows:—(1) The evolution of the water vapor in the sand. (2) The dissociation of clay in the sand. (3) The dissociation of silicate of alumina. (4) The decomposition of the limestone and magnesia. (5) The decomposition of compounds of Fe. In machined castings tested under pressure Léonard effect shows up clearly. Chills are used to present porosity. The shorter the freezing range of alloy the less possibility there is for the appearance of Léonard effect. The best irons from this point of view are those which approach the eutectic composition. AIK (3)

A Modern High-Output Steel Foundry. *Foundry Trade Journal,* Vol. 53, Sept. 12, 1935, pages 195-198. The works of Kryn and Lahy are described. Raw materials, melting plant, casting practice, sand practice, mold drying, etc. are discussed. AIK (3)

The Foundry of the British Northrop Loom Company. *Foundry Trade Journal,* Vol. 53, Oct. 31, 1935, pages 333-334. Description of the heating, lighting and ventilation equipment, oil-fired melting unit, etc., is given. AIK (3)

The International Foundry Exhibition. *Foundry Trade Journal,* Vol. 53, Sept. 12, 1935, pages 179-196. Detailed description of the exhibition held recently in England. AIK (3)

3a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Acid and Basic Bottoms of Copper Refining Furnaces. Edmund R. Thews. *Metal Industry,* London, Vol. 46, Apr. 26, 1935, pages 464-465; May 10, 1935, pages 513-514. One of the major factors upon which success and economy of Cu refining depends is the quality of the hearth and its composite material. The requirements of a satisfactory hearth are listed as (1) high resistance to heat and corrosion, (2) impenetrability towards metals and products of refining, (3) favorable mechanical properties, especially high strength and elasticity, (4) ability to make repairs simply and quickly, (5) ability to recover Cu imbedded in hearth material when repaired or renewed, (6) minimum wear by slagging and (7) maximum absorbtive power for the common impurities of Cu. No refractory material has, as yet, been developed to meet all of these requirements and silica is the oldest and still most important refractory employed. Magnesite bricks are the most satisfactory of the basic materials that have been used. The advantages and disadvantages of magnesite and silica hearths are described and compared. Other basic and neutral materials that have been tried are noted. The basic specification for the sand to be used in silica hearths and the most important rules for laying a silica hearth are listed. Burned-in hearths are discussed. This type of mixture tends to improve the density of the bottoms and to produce a better structure, making them more resistant to mechanical stresses, to absorb more impurities and to facilitate the removal of bottoms as well as to increase the recovery of Cu from bottom scrap. The most common materials listed as fluxing materials are Cu slag, Cu scale and basic clays. Precautions to be observed in the use of each are indicated. The old system of laying a bottom in 3 or 4 separate layers is not recommended. In discussion of sintering temperature, the need of preheating the furnace to 2200°-2350° F., a satisfactory method of installing a bottom, the burning-in at 2750° F., and the necessity of pyrometric control during burning-in are included. Two important rules to be observed after burning-in a hearth that the author offers are: (1) the furnace must be cooled down to a red heat before taking the first small charge of Cu for soaking the bottom and (2) the temperature drop must be as gradual as the temperature increase on heating up the furnace. The procedure to be followed is indicated. The advantages are that this annealing increases the elasticity, toughness and strength of the hearth and lengthens the life of the furnace. HBG (3a)

Vacuum Distillation of Metals. Part I. Refining Chromium, Aluminum and Silicon by Evaporation in a High Vacuum. W. Kroll. *Metal Industry,* London, Vol. 47, July 5, 1935, pages 3-6; July 12, 1935, pages 29-31; Aug. 2, 1935, pages 103-105. See *Metals & Alloys,* Vol. 6, Feb. 1935, page MA 46. HBG (3a)

Liquation Phenomena in Cast Bolt and Bar Brass (Seigerungserscheinungen in gegossenen Messingbolzen und -barren). Ch. Bernhoeft. *Zeitschrift für Metallkunde,* Vol. 27, May 1935, pages 115-116. A 58% Cu, 40% Zn, and 2% Pb brass was cast into uncooled cylindrical molds 180 mm. in diameter and 800 mm. long. Measurements showed that the lead content and Brinell hardness were both low in the center of the middle section. A 64% Cu, 36% Zn brass was cast into both water cooled and uncooled molds 600 x 65 mm. in cross section by 780 mm. high. The Cu content was low in the center at the top, middle, and bottom of the casting. GD (3a)

Applies Modern Methods to Production of High Quality Die Castings. Herbert Chase. *Steel,* Vol. 97, Nov. 4, 1935, pages 38-42. Describes practice of Schultz Die Casting Co., Toledo, O. in making Zn alloy die castings. Pressures averaging about 1500 lbs./in.^{2} and temperatures averaging 770° F. are used. These high pressures make possible use of very thin sections. Alloys are made at the plant. Melting furnaces and pots in casting machines are gas fired. All containers for molten metal are kept covered to avoid oxidation of metal. Casting machines were designed and built by the company and are similar to the conventional types but incorporate many refinements. Special care is exercised in the design and finish of dies, which may be H_2O cooled when required. Cleaning is done by machine wherever possible. MS (3a)

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Die-casting of Brass. John R. Freeman, Jr. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 371-380. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 276R/1. (3a)

Purification of Gallium by Fractional Crystallization of the Metal. James I. Hoffman & Bourdon F. Scribner. *Bureau of Standards Journal of Research,* Vol. 15, Sept. 1935, pages 205-209. If Ga, containing (as impurities) small amounts of Sb, Bi, Cr, Co, Cb, Cu, Au, In, Fe, Pb, Mn, Hg, Mo, Ni, Os, Pd, Pt, Rh, Ru, Ag, Tl, Sn, V, and Zn, is subjected to fractional crystallization of the metal, all the impurities named tend to concentrate in the crystalline portion, with the following exceptions: Ag, Hg, In, Pb, and Sn, are concentrated in the molten residue; Cu and Tl remain about equally divided between crystals and residue; Zn is dissolved by the HCl acid under which the crystallization takes place, and is entirely eliminated. It is also shown that separation from Fe or Pt in excess of 0.001%, from In or Pb in excess of 0.01%, or from Sn in excess of 0.02% by fractional crystallization of the metal is impracticable. WAT (3a)

Casting by Pressure (Le filage des métaux à la presse). P. Roux. *Métaux,* Vol. 10, Jan. 1935, pages 139-154. General principles and methods of pressure casting. GTM (3a)

The Manufacture of Pewter. F. Orme. *Metal Industry,* London, Vol. 46, Feb. 15, 1935, pages 195-198; Feb. 22, 1935, pages 222-224. Paper read at the Sheffield Local Section of the Institute of Metals, Feb. 8, 1935. A short history of pewter is outlined. It was used by the Chinese 2000 years ago, by the Romans, who obtained their tin from Cornwall, and in England from the 10th century until about 1840 when it was supplanted by china, earthenware, glass and enamelled ware. The theoretical composition of common pewter is 80% Sn and 20% Pb, with additions of Sb, Bi, and Zn. The analyses of a number of pewters are listed and several applications of the alloy are indicated. The old processes of manufacture are outlined. Modern pewter contains Pb only as an impurity and is essentially a Sn-Sb-Cu alloy resembling the best quality Britannia metal. The effects of the major and minor constituents are considered. The process of manufacture is discussed under the headings of (1) melting and casting, (2) refining, (3) pouring, (4) rolling, and (5) spinning. In a discussion of heat treatment of this alloy it is pointed out that rate of cooling has little influence on the properties but the maximum temperature attained in heat treatment, the rate of heating and the time retained at this high temperature do affect certain properties. Several comparisons of hardness of rolled and heat-treated pewter are included. The discussion of the microstructure of this alloy is illustrated with micrographs. HBG (3a)

Effect of Melting Conditions on the Running Quality of Aluminum Cast in Sand Molds. A. I. Krynitsky & C. M. Saeger, Jr. *Metal Industry,* London, Vol. 46, Jan. 25, 1935, pages 119-121, 128. Research Paper 727 of the National Bureau of Standards, Washington. See *Metals & Alloys,* Vol. 6, May 1935, page MA 179R/7. HBG (3a)

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3b. Ferrous

C. H. HERTY, SECTION EDITOR

The Perrin Process of Steelmaking. W. D. Pugh. *Iron & Steel Industry,* Vol. 8, Apr. 1935, pages 275-279. The aim of the Perrin process of steelmaking is to accomplish rapid dephosphorisation and deoxidation of steel and at the same time to reduce production costs. M. Perrin and his collaborators decided to attempt the reduction of P by intimately mixing the steel with a synthetic basic oxidizing slag previously melted in a separate furnace. Experiments were carried out in which the steel to be dephosphorised was rapidly poured into a ladle already containing a synthetic basic slag in liquid form, weighing about 10% of the amount of steel added. The first slag used consisted approximately, of 60-65% CaO, 30% FeO, and up to 10% SiO_2 with additions of fluorspar to increase the fluidity. The experiments were successful in that when using 15-ton casts of steel considerable dephosphorisation was effected in less than one minute. Examples show a reduction of from 0.436% to 0.045%, from 0.06% to 0.011%, and from 0.02% to 0.007%. In practice the steel is poured as rapidly as possible from the furnace so that it falls a distance up to 20 ft. into the ladle containing the prepared slag. CEJ (3b)

Production of Stainless Steels in Electric Arc Furnaces of Zaporojstal Works. V. G. Speranski. *Domez,* No. 6, 1935, pages 33-44. In Russian. During the first stages of the production of these steels heavy losses were caused by incorrect analysis and, particularly, by unsoundness of ingots. In melting 18% Cr-8% Ni and 17% Ni steels particular care should be paid to the elimination of H_2 which once introduced into the metal is difficult to eliminate causing unsoundness on freezing. Very detailed operating instructions for making this type of steels are given. For making sound 18% Cr-8% Ni steel C elimination should be 0.30%/hr., for 17% Cr steel it can be 0.40%/hr. Decarburization at 0.34% and 0.49% C/hr. respectively causes unsound ingots. Moisture in the charge is very undesirable and drying it before introduction in the furnace was recommended and used with good results in regard to soundness. Mn should be kept not lower than 0.15-0.20% during the whole boil. Before adding Cr metal is thoroughly deoxidized with Fe-Si. During melting of Cr it is better to keep the slag reduced by adding powdered FeSi. (3b)

Dirt Inclusions in Bottom Pouring of Steel. V. I. Lapitzki & A. A. Garkusha. *Domez,* No. 6, 1935, pages 25-33. In Russian. Bottom pouring as applied to 0.20% C plain C and Cr-Ni steels usually results, in the plant described in dirt inclusions up to 150 mm. in cross section. An investigation conducted for the determination of the cause showed that the inferior practice in preparing casting bottoms together with the poor quality of the fire brick used was the source of them. Microscopic and chemical analysis of these inclusions indicated a similarity between the nature of the inclusions and of the fire brick and luting clay used, though a certain amount of vitrification could be observed. Analysis does not permit associating them with the slag inclusions. Higher Mn content of the inclusions as compared to the original refractories, up to 4.65%, results from the accumulation on the surface of a floating piece of firebrick and non-metallic inclusions present in the steel in the liquid state. This is supported by high S content of the inclusions. (3b)

Bibliography of Non-metallic Inclusions in Iron and Steel. Lois F. McCombs & Morris Schrero. *Carnegie Institute of Technology & Mining & Metallurgical Advisory Boards, Coöperative Bulletin* No. 70, 1935, 308 pages. Contains 2136 references with brief annotations. See also *Metals & Alloys,* Vol. 6, July 1935, page MA 277L/1. AHE (3b)

Controlled Directional Solidification. George Batty. *Transactions American Foundrymen's Association,* Vol. 6, Feb. 1935, pages 237-258. The author shows that simple gravitation of metal super-imposed as feed heads is not competent in many cases to produce soundness in steel castings. The principle of creating correctly disposed temperature gradients in both mold and metal by well devised gating and heading, amplified in some cases by mold manipulation and/or by the application of external chills is one that must lead, by reason of controlled directional solidification, to the production of sounder and more dependable steel castings. Specially designed gating and heading procedure, together with details of mold manipulation, are described and the relation of molding materials to pouring temperature and pouring speed is discussed. CEJ (3b)

Heat Treating Cast Iron Pipe. J. B. Nealey. *Heat Treating & Forging,* Vol. 21, Aug. 1935, pages 382-384. Same as *Iron Age,* Vol. 135, May 23, 1935, pages 15-16. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 393L/3. MS (3b)

Gaseous and Solid Impurities in Ingots. J. H. Andrew. *Iron & Coal Trades Review,* Vol. 131, Oct. 4, 1935, pages 559-560. The view held generally of considering segregation in ingots mainly as due to differential solidification is discussed and some facts pointed out which cannot be explained by this theory, e.g. excessive segregation of C, S and P in large ingots, especially in the center of the ingot below the pipe cavity. Presence of metallic oxides and gradual but consistent generation of gas throughout the ingot is considered to cause the impurities to concentrate toward the center and top. Also inverse segregation is explained on this theory. Al as deoxidizer is successful, provided the product is not required to be rolled into sheets of high polish. Mo serves this purpose better and is recommended as addition to all Ni-Cr steels. Ha (3b)

Electric Steel Melting. Modern Shop Practice in America. R. P. Brown. *Iron & Coal Trades Review,* Vol. 131, Oct. 18, 1935, page 637. Discussion of an article in *Metal Progress.* Gives comparison with British conditions. Ha (3b)

Production of Sound Forging Steel for the Drop Stamper. N. H. Bacon. *Iron & Steel Industry,* Vol. 8, Aug. 1935, pages 436-439. A practical lecture and discussion of the production of sound forging steel. Type of charge, melting, removal of S, finishing additions, casting, judging of quality and rolling of ingots into billets are briefly considered. CEJ (3b)

Importance of Physico-Chemical Equilibrium in Production of Steel Containing Few Inclusions and of Uniform Composition (Sur l'Importance de l'Equilibre Physico-Chimique pour la Production d'un Acier Contenant Peu d'Inclusions et de Composition Uniforme). C. Benedicks & H. Löfquist. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 474-479. Includes discussion. To reduce slag inclusions in a steel bath to a minimum a physico-chemical equilibrium between the steel and the slag must be established. A deoxidizing agent may then be added to the steel so that the composition of the equilibrium of the slag is directly established. The Bessemer process produces a slag whose composition is almost that shown by the theoretical diagram. MAB (3b)

The Iodine Method for the Determination of Oxides in Steel. T. E. Rooney & A. G. Stapleton. *Engineering,* Vol. 139, May 24, 1935, page 554. From a paper read before the Iron & Steel Institute, May 1935. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 392R/4. LFM (3b)

Pipe Cast Centrifugally Without Chill. J. B. Nealey. *Industrial Heating,* Vol. 2, Aug. 1935, pages 411-415. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 393L/3. Ha (3b)

On the Cost and Upkeep of Open-hearth Furnaces (Ueber die Zustellungs—und Instandhaltungskosten von Siemens-Martin-Oefen). F. W. Morawa. *Stahl und Eisen,* Vol. 55, May 9, 1935, pages 509-515. The cost of various methods of construction and repair of different refractories are discussed. SE (3b)

Chilled Rolls. Geo. O. Loefler. *Foundry Trade Journal,* Vol. 52, June 20, 1935, page 416. The author discusses paper by Roxburgh published in the *Foundry Trade Journal,* Vol. 52, Apr. 11, 1935, pages 249-251 and abstracted in *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 393R/6. He points out that the addition of Mo materially improves the rolls in several ways. The large flakes of graphite in the gray Fe in the body of the roll are broken up into smaller size, the grain is refined, and the Fe is strengthened, as a considerable portion of Mo is dissolved in the ferrite. The chilled surface of the roll is also strengthened the grain refined, and there is a more uniform distribution of the hard particles. AIK (3b)

An Investigation into the Oxidizing Power of Basic Slags. Determination of the Binary Diagram CaO-Fe_2O_3. J. White, R. Graham & R. Hay. *Iron & Coal Trades Review,* Vol. 130, May 3, 1935, pages 765-766; *Engineering,* Vol. 139, May 31, 1935, pages 586-588; *Industrial Heating,* Vol. 2, June 1935, pages 311-312, 328. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 352R/9. Ha + LFM (3b)

Some Problems of Steel Melting. Earl C. Smith. *Transactions American Institute Mining & Metallurgical Engineers, Iron & Steel Division,* Vol. 116, 1935, pages 13-25; *Iron Age,* Vol. 135, Feb. 28, 1935, pages 33, 86, 88, 90. **Physical Appearance of Slag Indicates Quality of Steel.** *Steel,* Vol. 96, Mar. 18, 1935, pages 41-42. 12th Annual Howe Memorial Lecture, presented Feb. 1935. Points out the importance of refractories and slags in steel making. Reactions of the steel with both linings and slags are discussed. Chemical and petrographic compositions of open-hearth slags at various stages in the heat are given. JLG + VSP + MS (3b)

Determination of the Losses by Burning in the Cupola Furnace by Gas Analysis (Détermination de la Perte au Feu au Cubilot par l'Analyse des Gaz). Try-Chalons. *Revue de Fonderie Moderne,* Vol. 29, Oct. 10, 1935, pages 292-293. The method developed by Wm. McConnachie (*Foundry,* Apr. 1935) is explained and critically discussed. Although much more exact than methods which determine the losses in metal by weighing charge, product and slag, it is not considered accurate enough as it does not take account of the C in the combustion gases originating from the decomposition of the limestone (flux), and as the free O is not determined accurately enough. For comparing the performance of furnaces, however, the method is considered satisfactory. Ha (3b)

Some Notes on Ingot Molds. T. Swinden & G. R. Bolsover. *Foundry Trade Journal,* Vol. 53, Aug. 1, 1935, pages 81-83; Aug. 8, 1935, pages 102-104; *Sheet Metal Industries,* Vol. 9, Aug. 1935, pages 483-485, 490; *Engineer,* Vol. 160, July 26, 1935, pages 72-73, 100-102. From a paper read before the Institute of British Foundrymen, Sheffield, July 1935. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 441L/2. AIK + AWM + LFM (3b)

Produces Wide Range of Iron Castings in Steel Foundry. William F. Rose. *Steel,* Vol. 97, Nov. 4, 1935, page 46. Regular steel foundry practice and green-sand facing are used in production of high-test and alloy Fe castings. Hard ramming and highly permeable sand produce clean castings with sharp corners. MS (3b)

Some Experiments with Austenitic Cast Irons. P. A. Russell. *Foundry Trade Journal,* Vol. 53, Oct. 31, 1935, pages 325-327. This paper, presented on behalf of the Institute of British Foundrymen to the French Foundrymen's Association, is concerned with austenitic cast iron of the type that is known in Great Britain and America as Ni-Resist. The standard composition usually recommended is as follows: Tot. C 3.00, Si 1.50, Mn 1.00, Ni 12.00-15.00, Cu 5.00-7.00 and Cr 2.00%. It was noticed that increase in Cr has little effect on the strength but increases the Brinell hardness. Observation of the shrinkage of these irons shows that the rotary furnace metal with its higher Si and lower S gives much less shrinkage than the cupola melted metal. The author concludes that, providing that ductility is not an important factor, the best composition of Ni-Resist for castings of intricate design is as follows: Tot. C 2.5-2.8, Si 1.8-2.2, S 0.08 max., P 0.30 max., Mn 1.0-1.5, Ni 13-16, Cu 5-7 and Cr 1.5-2.5%. If, however, ductility is important, then the standard Ni-Resist with C about 3% should be used, while the maximum ductility and softness is obtained by omitting Cr, the strength of the Fe falling off considerably thereby. The characteristic feature of the microstructure is the appearance of well-defined constituent with the introduction of Cr. This constituent usually appears in one or two distinct arrangements, either as a fan-shaped aggregation or in long streaks. The phosphide eutectic appears to be associated with the Cr carbide, and observation of a specimen before and after etching with Stead's reagent shows that the usual fan structure is broken up by the phosphide eutectic. AIK (3b)

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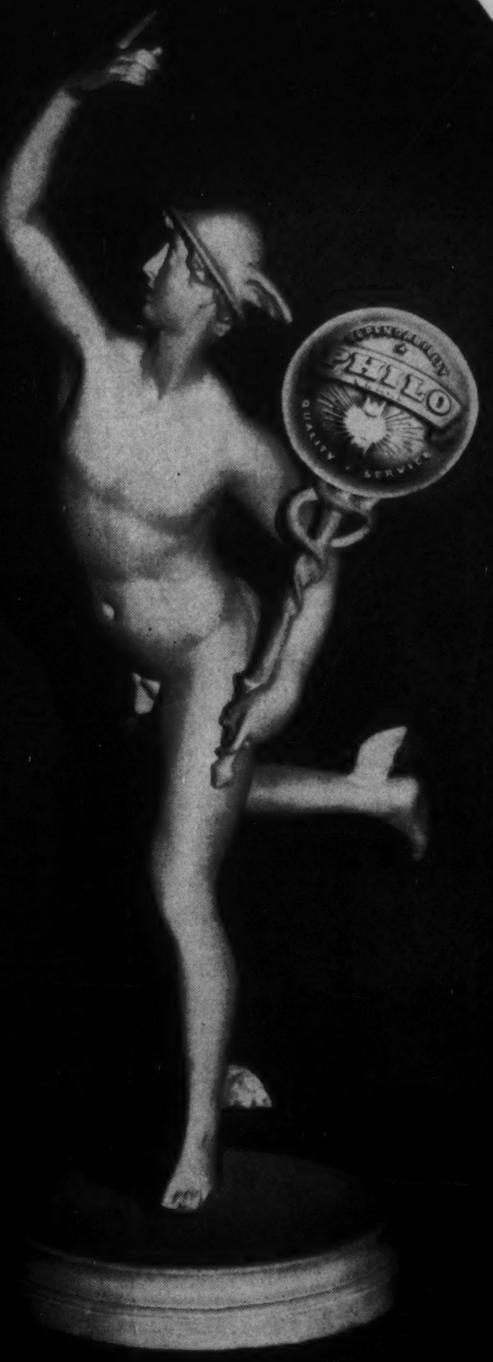
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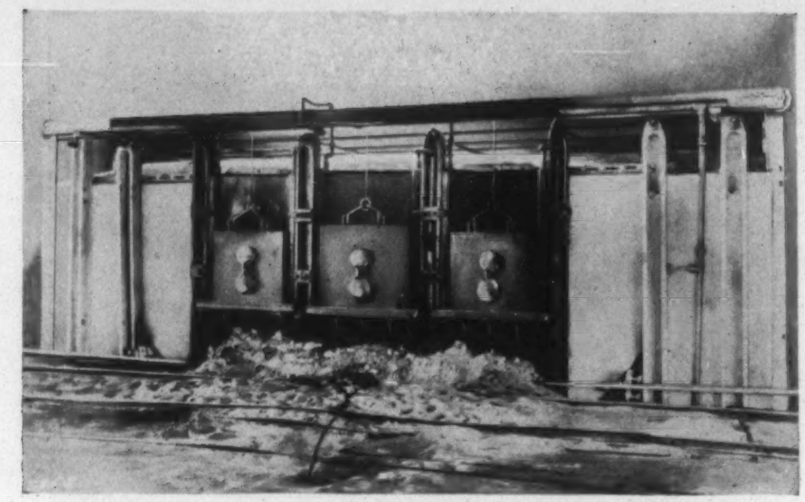

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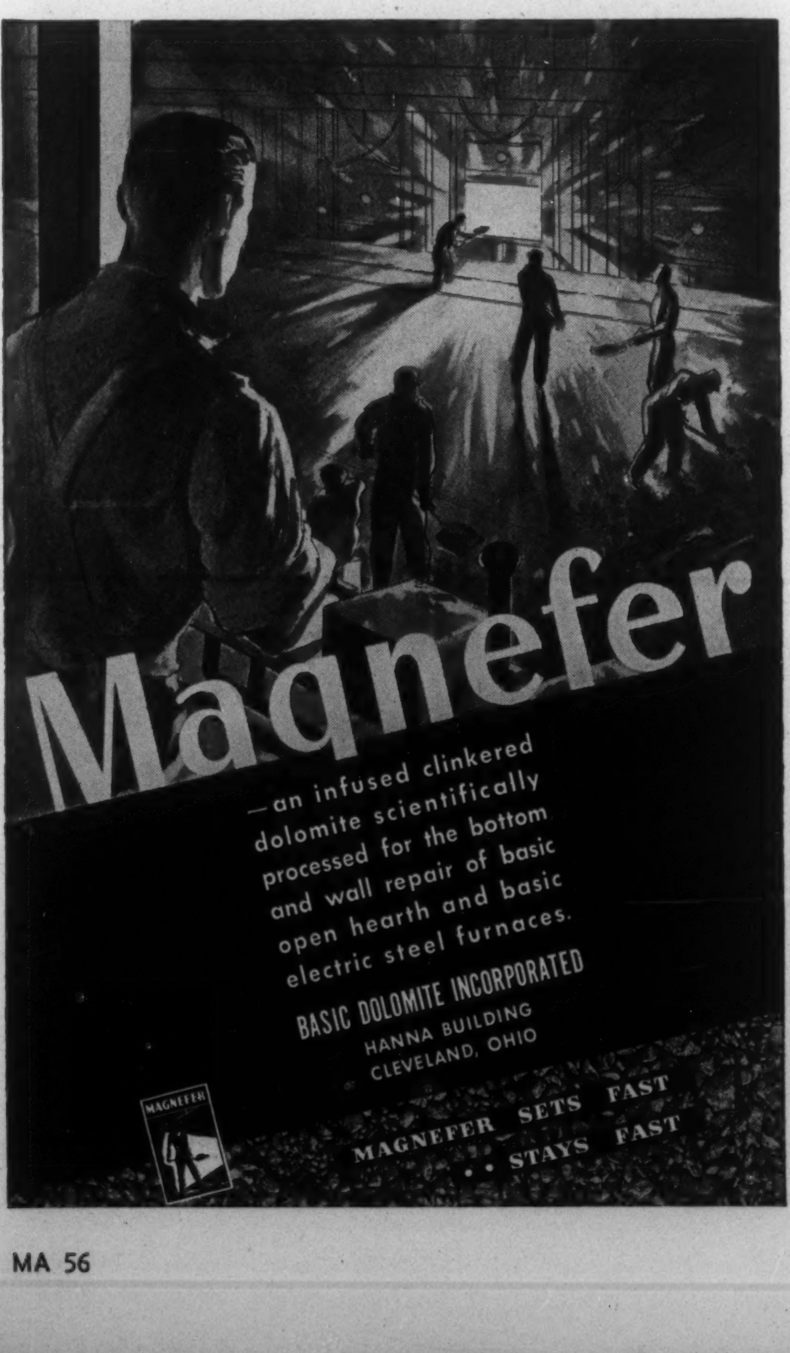
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The British Cast Iron Research Association. *Foundry Trade Journal,* Vol. 53, Oct. 31, 1935, pages 331-332. An abstract of the Annual Report of the British Cast Iron Research Association. Sand and refractories, gray Fe, alloy cast Fe, etc., are discussed. The method of graphite refinement was developed. Irons of coarse and open structure containing ordinary amounts of total C are treated to yield graphite in the finest possible form by including in the charge a small amount of Ti of the order of 0.2%. This element can either be incorporated in the pig-irons or can be added to the ladle of molten metal. The molten metal is then treated with an oxidizing gas, preferably CO_2. The experience gained in both crucible and cupola melts has suggested that the graphite structure of cast Fe is governed by the nature and distribution of the slag in the metal and arrangements are contemplated for a more complete examination and analysis of these slags. AIK (3b)

Suggestions for Research on Steel Castings. J. H. Andrew. *Foundry Trade Journal,* Vol. 53, July 18, 1935, page 49. A paper read before the Annual Meeting of the Institute of British Foundrymen, July 1935. Perhaps the greatest trouble experienced with castings is with respect to contraction cavities, and blowholes. Research carried out with a view to systematizing the method of feeding and arrangement of heads might well be undertaken. The discovery of an element that when added to steel would reduce the fluid-solid contraction would be invaluable, and this might well be made the subject for investigation. It is an open question as to whether an oxygen-free steel is desirable from the standpoint of its strength. Recent research undertaken in the author's laboratories has indicated that the tensile strength of steel drops very markedly when all the oxygen is removed. Provided the oxygen remains dissolved in the steel it may possibly be an asset rather than otherwise. A correctly heat-treated casting may give tests equal to the same material in a forged condition. Thus, it is possible that castings which can be heat-treated might readily replace the more costly forged material. The effect of casting temperature upon fluidity is at present receiving considerable attention. There is some reason for the view that the oxygen content of the steel is the controlling influence, so that to make research on fluidity of the greatest value, the oxygen content of the metal should be determined by careful analysis. AIK (3b)

The Utilization of Electric Arc Furnace. M. Boutigny. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, page 234. Abstract of paper presented to the International Foundry Congress in Brussels. The author has devoted a considerable amount of space to dealing with the regulation of arc both during melting and refining steel and cast Fe. Then he deals with the metallurgical reactions which take place when operating an electric furnace under both basic and acid conditions. The last part of the paper is devoted to duplexing. Under these conditions the electric furnace can have its transformer capacity reduced between 58 and 60%. The author deals with 4 processes, combinations of the basic Bessemer, the rotating furnace, the cupola and the blast furnace with the electric furnace. The great advantage of utilizing an electric furnace in conjunction with a cupola is that it is easily possible to superheat the metal and this destroys any graphite nuclei which may exist in the metal. Superheating brings into being a carbon eutectic, with which is to be associated metal of high fluidity, mechanical strength, and resistance to wear and heat. AIK (3b)

4. WORKING

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Cold Rolling (Die Kaltwalzung). L. WEISS. *Zeitschrift für Metallkunae,* Vol. 27, Apr. 1935, pages 73-75. It is shown that by the use of 2 arbitrary factors which were developed previously (*Zeitschrift für Metallkunde,* 1928, page 280, and 1931, page 47), and which evaluate the effect of dynamic working during the rolling process and of initial thickness of the material upon yield point of the material, it is possible to estimate the resistance of the material to deformation. By this means the effects upon rolling pressure of the roll diameter and of friction between rolls and material are calculated and shown to be in agreement with experimental values. A graph is developed which relates possible reduction in thickness to roll diameter, original thickness of the material, and frictional conditions. The limitations placed upon rolling pressures by elastic deformation of the rolls are described and related to possible reduction of thickness. GD (4a)

Rejuvenating Tank for Roll Neck Bearings. S. F. KEENER. *Steel,* Vol. 96, Apr. 29, 1935, page 50. Abstract of paper read before the Association of Iron & Steel Electrical Engineers, Apr. 24, 1935. See "Field Drawing of Roll Neck Bearings," *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 444R/5. MS (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Evolution of Steel—Shapes Processing. L. M. WAITE. *Iron Age,* Vol. 136, July 25, 1935, pages 18-20, 78, 80. Describes a new pneumatic-hydraulic 14,000 ton extrusion press. Its application has led to scientific possibility of extruding and piercing ferrous metals directly into shapes from ingot or billet in plastic condition. VSP (4b)

Extrusion of Copper and Its Alloys (L'extrusion du Cuivre et de ses Alliages). L. MATTEOLI. *Cuivre & Laiton,* Vol. 8, July 30, 1935, pages 301-307. Direct and indirect extrusion methods, fabrication of Cu pipes, and equipment are described. Proper extrusion temperatures for Cu, Zn, Al and some of their alloys are mentioned. Ha (4b)

4c. Cold Working, including Shearing, Punching, Drawing & Stamping

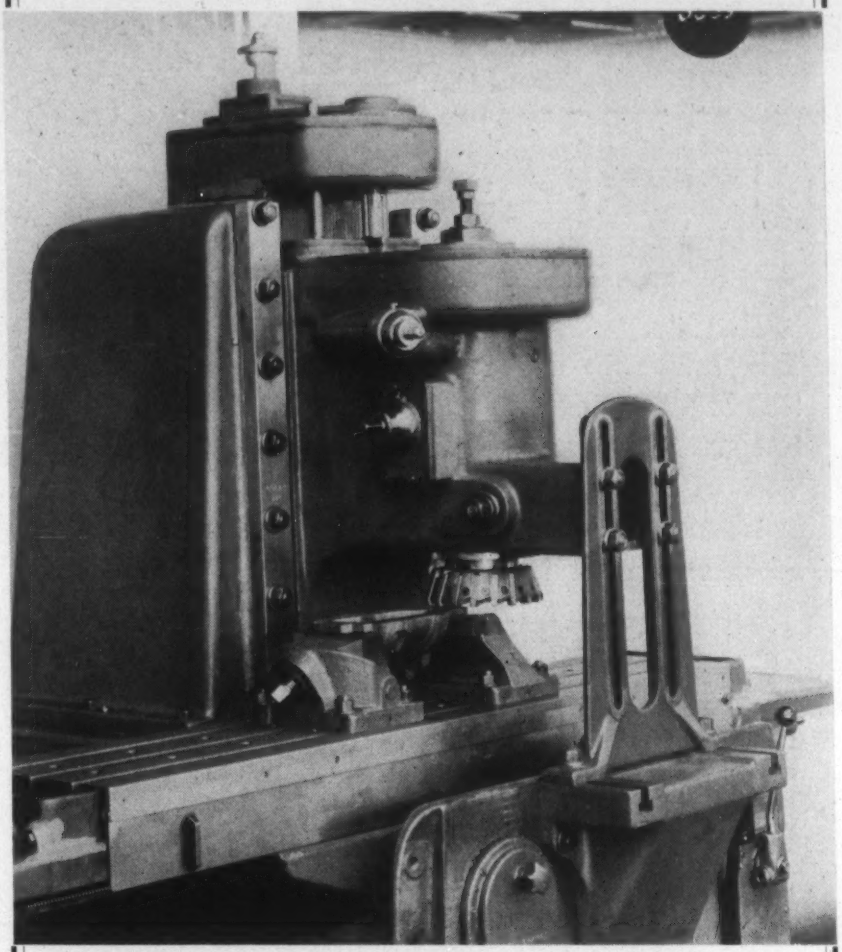
Cold Drawing Alloy Steel. RICHARD SAXTON. *Heat Treating & Forging,* Vol. 21, Sept. 1935, pages 430-432. Correct heat treatment is essential for efficient cold working of alloy steels. Because of low thermal conductivity of these steels, this operation must be performed at a slower rate than with C steels. Cold working methods differ little from C steel reduction practice, except that majority of drafts are lighter. Average reduction per draft with alloy steels is about 1 size S.W.G. in thicker sizes and 0.5-0.75 in sizes smaller than 15 S.W.G. High-speed steels are given an intermediate heat treatment after each second draft. When heating for initial draft, material should be raised slowly from 400° to 1250° C. with furnace, allowing 1 in./hr. of diam. for soaking. It should be cooled slowly with furnace. Stainless steels are given 2 drafts between heat treatments. They require slowest practicable heating up to 700° C. after which speed may be increased. Austenitic class is annealed by first heating to 1050°-1100° C. and quenching in H_2O, and can be reduced about 65% before further annealing is necessary. For heat treatment between drafts material is raised to 825°-850° C. Mn steel is very difficult to reduce by cold work, only lightest drafts being permitted. It is annealed by raising to 1000° C. and quenching in H_2O. MS (4c)

4d. Machining

H. W. GRAHAM, SECTION EDITOR

Machining of Stainless Steels (Usinage des aciers inoxydables). ANDRE MICHEL. *Métaux,* Vol. 9, Oct. 1934, pages 457-459. Martensitic steels (12-16% Cr, 0.2-0.4% C) are machined when they have a Brinell hardness of 170-200. A soluble oil is preferably used and in order to facilitate the machining further 0.2-0.4% S is also added to these steels. Ferritic steels with less than 0.12% C and with 18% Cr offer not much difficulty in machining. Austenitic steels are characterized by their tenacity and ductility and their wearing properties. GTM (4d)

A Study of the Machining Problem with Particular Reference to Cast Iron. H. H. BEENY. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, pages 227-231. British exchange paper presented to the International Foundry Congress in Brussels. There are 4 aspects of the machining quality of a metal which are: (1) The cutting speed with a given type of cutting tool, (2) The life or endurance of the cutting tool, (3) The finish on the machined surface, (4) The power consumed by the tool or machine in making the cut. The metallurgical properties of metals which affect machining quality in various degrees are as follows: chemical composition, physical structure, static strength, Brinell or indentation hardness number, ductility, dynamic strength, work-hardening qualities. The important active constituents in gray cast iron are: (a) graphite flakes, (b) combined carbon both massive and pearlitic, (c) phosphide eutectic. The influence of C, S, Mn, Si and P on machinability of cast Fe and drilling machine tests are discussed. AIK (4d)



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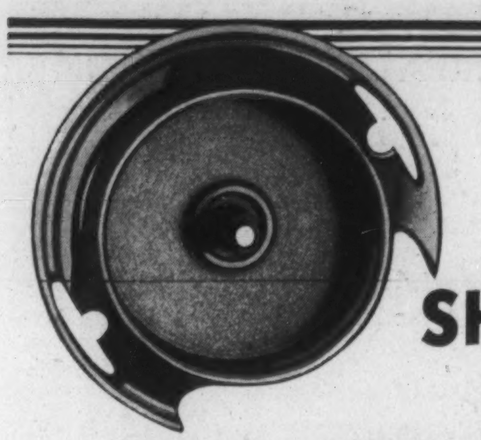

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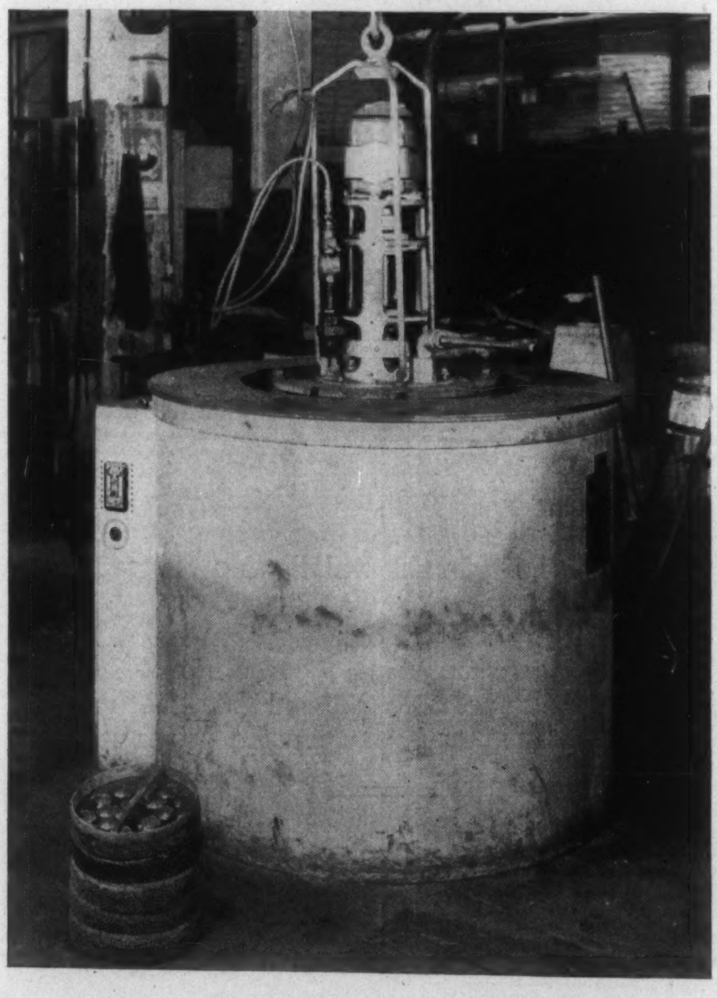

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5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Controlled Protective Atmospheres for Furnace Use. A. R. Ryan. *Industrial Heating,* Vol. 2, Nov. 1935, pages 633-640. "Protective atmosphere" in general refers to a gas or gases which are introduced into a furnace for the protection of the surface of the goods to be heated against undesirable changes. The behavior of metals in the presence of such gases to prevent oxidation, carburization or decarburization is discussed and the chemical changes which can go on under elevated temperature are explained. Methods of purifying the gases, types of gases used and control of the atmosphere as dependent on the heat treating process are described. Ha (5)

Control of Grain Size and Structure in Large Forgings by Heat Treatment. G. J. Horvitz & G. Brinton Jack, Jr. *Iron Age,* Vol. 136, Sept. 26, 1935, pages 48-50. Forgings of medium C steel class, when used under service conditions involving alternate stresses, have highest resistance to fatigue under certain conditions of grain refinement. Ultimate grain size and structure are dependent on heat treatment and nature of thermal treatment during which forging is wrought. With proper thermal range in forging operations and heat treating procedure involving a quench and a draw, suitable structure is obtained. Points to be observed in heat treatment of material in this class are: (1) Proper size and type of furnace, with pyrometric and burner control; (2) Calculation of time and temperatures from design and chemical analysis; (3) Sufficient soaking to insure complete austenitic solution; (4) Proper mechanical handling; (5) Cooling capacity of quenching equipment should be sufficiently large; (6) Atmospheric control to prevent surface decarburization, scaling, etc.; (7) Proper rough turning and hollow boring before quenching; (8) Time quenching to prevent strain; (9) Placing in tempering furnace after quenching; (10) Correct specification; and (11) Final inspection. VSP (5)

■ 5a. Annealing ■

Tempering Steel Forgings by Recirculation. C. Foster Clark. *Industrial Gas,* Vol 14, Oct. 1935, pages 13, 22. The economies possible by introducing the recirculation of hot air in the tempering furnaces are discussed. A furnace of this type is described. Ha (5a)

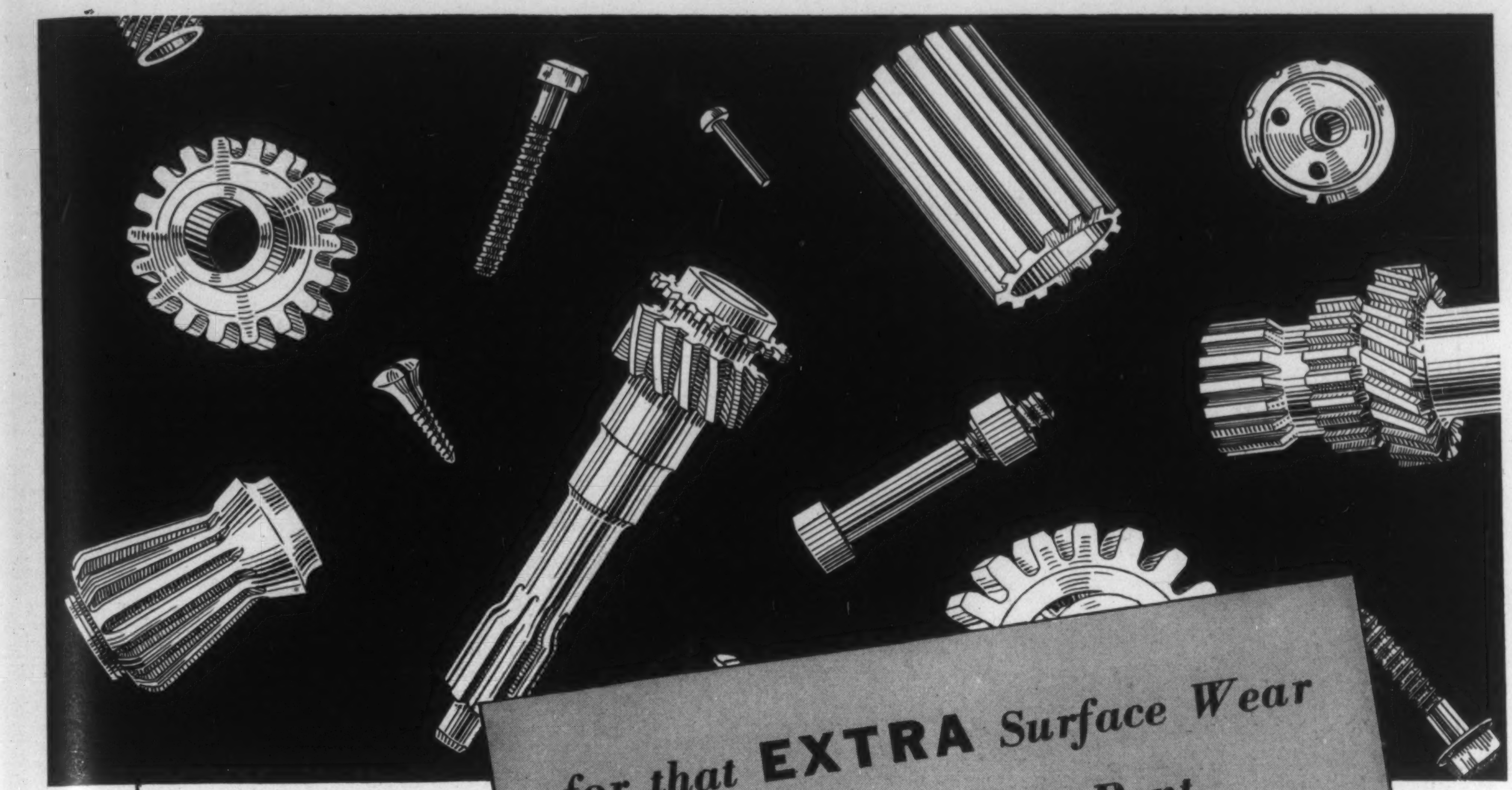
Reduces Defects in Steel Rails by Normalizing. John Brunner. *Steel,* Vol. 97, Oct. 21, 1935, pages 32-34. Similar to *Railway Age,* Vol. 98, Mar. 2, 1935, pages 325-328. See "Normalizing Process Perfected for Rails," *Metals & Alloys,* Vol. 6, May 1935, page MA 185L/1. MS (5a)

■ 5b. Hardening, Quenching & Drawing ■

The Surface Hardening Treatment Applied to Cast Iron. J. E. Hurst. *Iron & Steel Industry,* Vol. 8, May 1935, page 314. The method of surface hardening steel articles by oxy-acetylene flame treatment as typified by the Shorter process is familiar to most engineers. This rapid superficial heating causes temperatures high enough to bring about surface hardening after quenching. Two types of cast iron were used in the experiments. No. 1 containing 3.08% T. C., 0.10% C. C., 2.98% graphite, 2.84% Si, 0.96% Mn, 0.03% S, 0.88% P, 0.05% Ni, 0.06% Cr. No. 2 containing 3.01% T. C., 0.41% C. C., 2.60% graphite, 2.21% Si, 0.79% Mn, 0.045% S, 0.74% P, 1.07% Ni, 0.42% Cr. Hardness determinations made on the machined surfaces of the test bars in the normal condition prior to surface hardening treatment gave results of 217 and 228 on specimens No. 1 and No. 2 respectively, while the hardness values of the hardened surfaces were 460 and 470, respectively, with a total depth of the surface hardening effect of 1/16" in each case. CEJ (5b)

Heat Treating Rail Ends by New Process. *Railway Engineering & Maintenance,* Vol. 31, July 1935, pages 415-416. Describes rail surface hardening process developed by the Oxweld Railroad Service Co., Chicago. A sufficient number of oxy-acetylene flames are employed so that the rail ends can be brought to a high temperature before the rail has been heated materially. The body of the cold rail provides the quenching medium. The hardness of the rail is raised 100 Brinell units. The average performance is 60 joints/hour. WH (5b)

Present Status and Prospects of Autogenous Surface Hardening (Stand und Aussichten der autogenen Oberflächenhärtung). E. Zorn. *Autogene Metallbearbeitung,* Vol. 28, Oct. 15, 1935, pages 305-310; Nov. 1, 1935, pages 321-325. Contrary to the procedure in ordinary quench hardening, not the whole piece but only the surface layer or that part of it which is to be hardened is heated to the quench temperature and quenched before the heat can penetrate into the interior. No hardening elements, e.g. C. are added; the material must contain them. In order to reach the required temperature more heat must be supplied to the surface layer than can flow into the core; the oxy-acetylene flame is best suited for this process, especially under high pressure acetylene. The materials suitable for this method of hardening are forged C steels, forged alloy steels, as Cr-Ni and Cr-Mo steels with 0.35% C, 0.2 Mo and 1% Cr, unalloyed and alloy cast steel, and cast Fe; they should contain 0.4-0.6% C. The quench temperature for cast Fe can be calculated by the equation $t = 730 + (28 \text{ x } \% \text{ Si}) - (25 \text{ x } \% \text{ Mn})$. Shapes of burners and automatic hardening machines are described and the application of the process illustrated by examples of gears, crankshafts, couplings. An investigation of the economy of the method is carried out with respect to oxygen consumption, width of flame, and speed applied. The principal field of its application is seen in cases where hardening is advisable but was not done for some practical reason. 10 references. Ha (5b)



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Shorterizing, A New Old Method of Surface Hardening. T. W. Lippert. *Iron Age,* Vol. 136, Aug. 8, 1935, pages 12-17, 95. The Shorter process is essentially a mechanically operated oxy-acetylene blow pipe which traverses the object to be hardened at a predetermined speed. Quenching is effected by a coordinate jet of H_2O, air or N, which followed immediately behind. Simple though the set-up appears, there are a number of variables which must be regulated to obtain satisfactory results, such as proper blow pipe flame which must have constancy and predetermined energy, and distance between blow pipe and cooling jet must be determined. In treating cast Fe combined C should be from 0,5 to 0.6%. Many alloy steels as well as C steel respond to this treatment. Considers investigations made by various authorities. Includes tables giving the effect of Shorter surface hardening on various alloy steels. VSP (5b)

Heat Treatment of Several Bronzes (Wärmebehandlung und Aushärtung einiger Mehrstoffbronzen). M. Hansen. *Metallwirtschaft,* Vol. 14, Aug. 30, 1935, pages 693-696. The physical properties of rolled and pressed bars of Al bronze vary considerably due to variation in cooling conditions. During cooling from hot working temperatures Al bronze passes through several phases as shown by the constitutional diagram. Samples of the alloy 83% Cu, 11.5% Al, 5.5% Fe were heated to 500° to 800° C. for 1 hour, some quenched in water and others cooled in air. The tensile strength and elongation were increased considerably by quenching from 600° to 650°. The tensile strength was 100 kg./mm.^{2}, yield point 56 kg./mm.^{2} and elongation 9%, compared with 70 and 55 kg./mm.^{2} and 2.5% for the air cooled samples. The properties obtained by air cooling did not vary materially. Quenched from 600°-650° the alloy consists of $\alpha + \beta' +$ Fe, while the air cooled alloy contains γ', which is very brittle. Al-Ni bronzes also respond to heat treatment and the properties of rolled bars vary unless their cooling is controlled. In the alloy 13.1% Ni, 2.17% Al, .96% Mn, .46% Fe, balance Cu the highest tensile strength, yield point and hardness were obtained by quenching from 900° and drawing at 550° for 20 hours. The elongation was reduced very much. The microstructure of a rolled bar without subsequent heat treatment showed banding in the rolling direction and finer grains than a heat treated bar which showed no banding. CEM (5b)

Hot Working and Heat Treatment of Stainless Steels. O. K. Parmiter. *Industrial Heating,* Vol. 2, Sept. 1935, pages 461-466. A list of alloy steels giving their composition and particular fields of application is given and complete details of heat treatment for each type described. Ha (5b)

Special Hardening Treatment of Crankshafts (Tratamiento especial para el Endurecimiento de los Cuellos del Cigüeñal). J. C. Ruiz. *Metalurgia y Construcción Mecánica,* Vol. 1, Oct. 1935, pages 10-12. Methods for surface hardening of crankshafts of Diesel engines as practiced in the U. S. A. and Germany are reviewed. Ha (5b)

Cobalt Magnet Steels. L. Sanderson. *Heat Treating & Forging,* Vol. 21, Aug. 1935, pages 367-368. See *Metals & Alloys,* Vol. 6, July 1935, page MA 280R/8. MS (5b)

5c. Aging

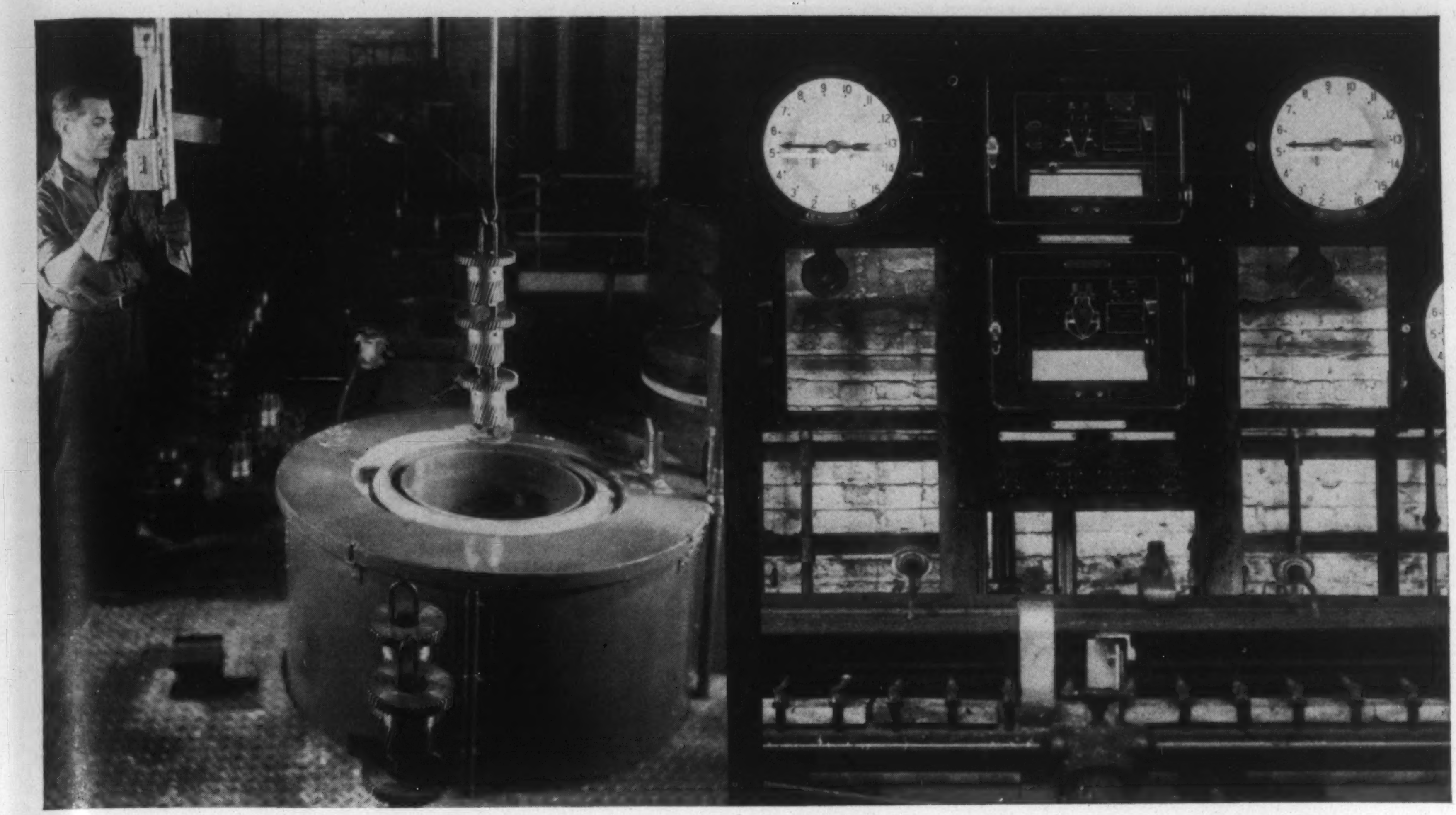
Examination of Steel Wires Artificially Aged (Examen des Fils d'Acier par Vieillissement Artificiel). A. Glazunov. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 583-587. Includes discussion. The quality of a steel is usually determined by its chemical analysis and structure. The author studied the causes of aging, which depend neither on the amount of C, nor S, nor P, any more than on the mechanical values obtained before tempering. He describes his tests which may be used to avoid the dangers which may arise due to aging. MAB (5c)

Effect of Nitrogen and Oxygen on the Mechanical Aging of Steel (Einfluss von Stickstoff und Sauerstoff auf die mechanische Alterung von Stahl). W. Eilender, H. Cornelius & H. Knüppel. *Archiv für das Eisenhüttenwesen,* Vol. 8, May 1935, pages 507-509. Small 700 g. melts of electrolytic Fe to which C, N_2, and O_2 were added to give up to 0.19, 0.020, and 0.18% of C, N_2, and O_2 respectively were tested in impact before and after aging. The aging treatment consisted of cold working 10%, followed by heating at 250° C. It was concluded that N_2 raises the sensitivity to aging embrittlement, C has a slight effect, and that O_2 has no effect. Se (5c)

Hardening of Solid Solutions (Age Hardening) (Om fasta lösningars hardnande ("tidshärdning")). Gunnar Hägg. *Jernkontorets Annaler,* Vol. 119, July 1935, pages 295-300. Reply to Benedick's theory developed in the June issue of this periodical. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 447L/7. HCD (5c)

5e. Carburizing

Investigation of Materials for Sewing Machine Parts. I. Study of Materials and Heat Treatment of Ready-made Sewing Machine Parts. II. On the Gaseous Cementation and Abrasion Test of Some Sewing Machine Parts. H. Kishimoto. *Kinzoku-no-Kenkyu,* Vol. 11, Oct. 1934, pages 518-528; Vol. 12, Oct. 1935, pages 309-314. In Japanese. The various sewing machine parts, imported and home made, were examined under the microscope, as-received and after normalizing. The materials of which the machine parts are made and their heat treatments were determined. The depth of cementation and the C content at the surface were measured by the microscope micrometer. The hardness of the parts was measured by the Rockwell hardness tester. From these data it was inferred that the materials were probably subjected to gaseous cementation, which is the next subject of the investigation. Cementation by city gas was carried out with Armco iron and sheet bar. The effect of the composition of specimens on the depth of cementation was studied by carburizing under the same condition. By changing the velocity of gas passing over the specimens the best condition was determined. The depth of cementation was measured for various lengths of time and temperatures. 3 kinds of sewing machine parts were made under the best conditions as determined by the present work, and the abrasion test was carried out to compare the parts with those in the market. HK (5e)



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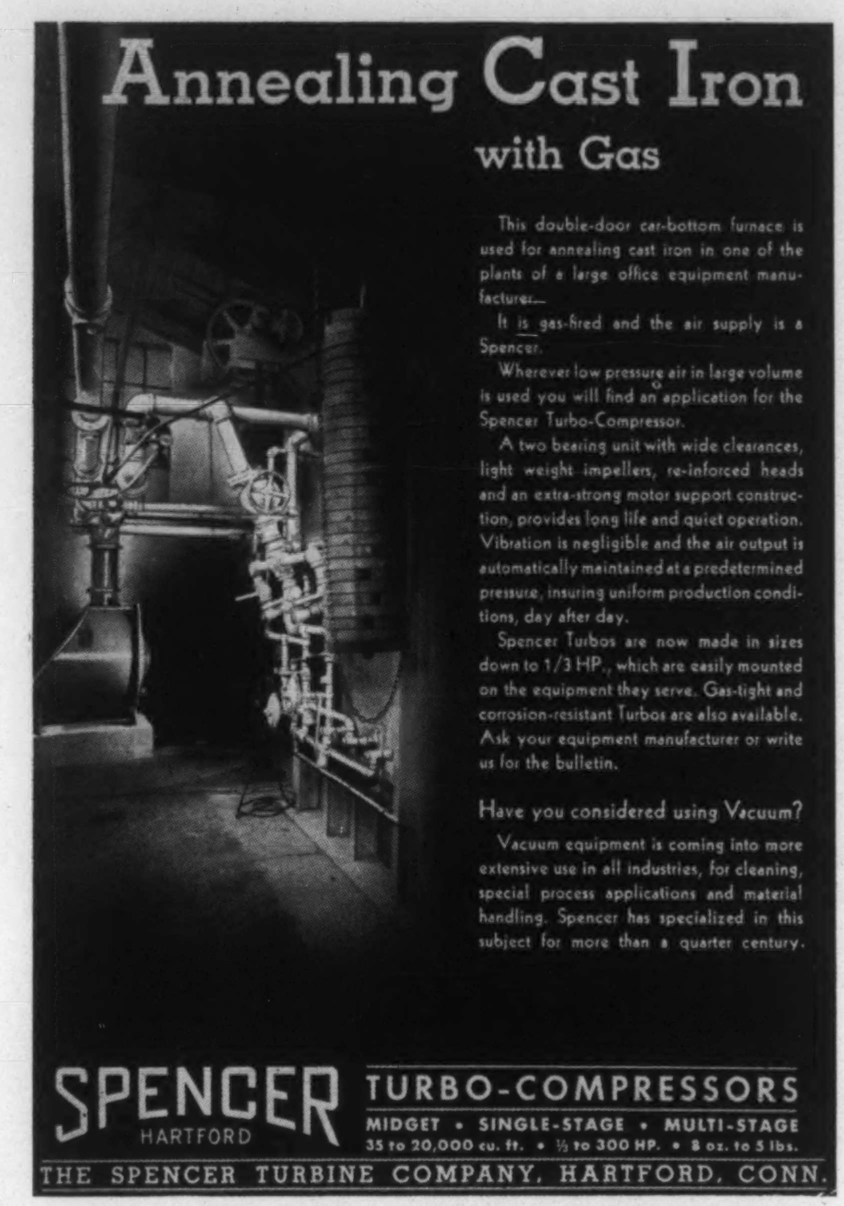

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Case Hardening and Case Hardening Steels. T. W. Hardy. *Iron & Steel of Canada*, Vol. 18, July-Aug. 1935, pages 51-53; Oct. 1935, pages 70-74. The processes of case-hardening, i.e. the production of the case by carburizing or cementing, the refining of the core, the refining and hardening of the case, and the tempering of the hardened case, and the media used for case hardening, the steels best suited for the treatment, and the physical properties of the hardened material are discussed. Ha (5e)

Method for Speeding Cementation of Iron by Metals. K. P. Bunin. *Domez*, No. 3, 1935, pages 33-35. In Russian. Studying the law of diffusion $1° g\ C = f(x^2)$ where x is the distance from the surface of diffusion and C concentration at the depth x one can see that in the region of γ-α transformation where solid solutions are possible the concentration remains practically constant. At a certain distance from the cementation surface the speed of diffusion reaches a maximum corresponding to γ-α transformation zone gradually moving into the metal. It was assumed that the speed of cementation would be increased when the absorbing metal is continually present in the state of allotropic transformation. By letting the temperature oscillate a fixed interval, 10° C. for example, above and below the critical temperature a superficial layer might be produced the concentration of which would call for a higher temperature than that allowed by such an oscillation. Better results would be produced when these oscillations are allowed to cover the gradually increasing gap between the Ar_3 and Ac_3 curves to take care of this phenomenon. Filling specimens of steel with Fe-P and heating them for 3 hours 40 minutes in one case at 970° C. and in the second varying the temperature between 880° and 970° C. showed that in the second case the depth of diffusion was 70% greater than in the first. (5e)

■ 5f. Nitriding ■

New Ways of Hardening (Neue Wege der Härtungstechnik). Freitag. *Oberflächentechnik*, Vol. 12, Oct. 1, 1935, page 237. According to a new process (DRP 575,599), the nitriding process which ordinarily takes about 16 hrs. at 460°-580° C., can be accelerated if N-containing organic compounds are present in the ammonia gas, preferably carbo-cyclic compounds like aniline, nitrobenzol or pyridine, which do not complicate the hardening process nor increase its price. The ammonia gas flows through the liquid and carries away small amounts of it in vaporous form. An iron alloy with 95.5% Fe and 1% Al could be hardened in 4 hrs. and had a uniform, resistant case of Brinell hardness 1000. Another method of acceleration consists in using a gas mixture of 40% ammonia and 60% nitrous oxide which gave the same hardness in 4 hrs. at 460° C. In the presence of certain, preferably non-ferrous metals ammonia gas effects a considerable acceleration of the hardening process. If for instance, the piece to be hardened is surrounded by a mesh of Cu wire of about 0.45 mm. diam. the time could be shortened from 16 to 4 hrs. Using the before-mentioned gas mixture as hardening atmosphere shortened the time to 2 hrs. and also resulted in Brinell hardness 1000. Ha (5f)

6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Controlled Luminous Flame. J. B. Nealey. *Heat Treating & Forging*, Vol. 21, Sept. 1935, pages 443-444; condensed in *Steel*, Vol. 97, Sept. 9, 1935, page 39. In this new method of burning gas, a fan delivers air through an orifice plate where it is metered and then conducted to furnace. Gas is also metered and is delivered to system at 6 oz. total pressure, which is controlled by a sensitive regulating valve. Supply of gas at furnace port is controlled by calibrated valves which register flow rather than % of opening. MS (6)

The Electric Furnace in the Non-Ferrous Foundry. A. G. Robiette. *Foundry Trade Journal*, Vol. 53, Aug. 22, 1935, pages 131-133; Sept. 19, 1935, pages 213-214. Detroit rocking arc furnace origirated by Gillett and Rhoads at the U. S. Bureau of Mines is described. An investigation of the atmosphere obtaining in the rocking-arc furnace conducted by the Bureau of Standards showed no more than a trace of 0 during the melting period, the main constituents being CO (30-40%), CO_2 and N. Various kinds and forms of refractories have been tried and used in the rocking-arc furnace. High-alumina firebrick will give a satisfactory life on brasses although the tendency at present is to use a more highly-aluminous material. Foundry requirements, electric brass melting, mixing action of furnace, refractory materials, metal loss, absorption of gases, temperature control, melting of Ni alloys, results of practice and operating costs are discussed. AIK (6)

Refractories for Foundry Use. W. J. Rees. *Foundry Trade Journal*, Vol. 53, July 18, 1935, pages 47, 48. A paper read before the Annual Meeting of the Institute of British Foundrymen, July 1935. In the modern cupola, very high temperatures are reached and good deal of mechanical stress is prevalent. It is quite evident from the melting point curve of alumina-silica mixtures that the brick should be either high in alumina or high in silica. Unfortunately, the silica brick does not satisfactorily resist very rapid heating or cooling. So from the point of view of refractoriness, the high-alumina types of firebrick must be considered. The pressure on bricks in the cupola may reach as much as 30 to 40 lbs./in.^{2} The desirable brick for cupola service, therefore, will be one which has a wide deformation range. Glaze and abrasion resistance, black cores in bricks, corrosion resistance, close jointing, rammed lining and patching materials are discussed by the author. AIK (6)

Factors to be Considered in the Insulation of Open-hearth Furnaces. G. Soler. *Industrial Heating*, Vol. 2, Oct. 1935, pages 591, 604. General discussion of requirements for heat insulating materials. Ha (6)

Test Data on Stiff Mud Refractories Made from Georgia Sedimentary Kaolins Using Void Control. W. Harry Vaughan. *Journal American Ceramic Society*, Vol. 18, Sept. 1935, pages 284-287. Properties, texture and composition of the Georgia clays are given as well as working character, drying characteristics Pyro-physical properties are given in tabular form for 3 different brick compositions under a variety of conditions. WB (6)

Tar for Steel Plants (Untersuchung von Stahlwerksteeren). H. J. van Royen, H. Grewe & K. Quandel. *Archiv für das Eisenhüttenwesen*, Vol. 8, May 1935, pages 479-488. For steel plant purposes it is sufficient to determine the specific gravity, viscosity, and naphthalene content of the tar, to be able to detect unsuitable material. Typical materials and test methods are described. SE (6)

Refractories and Sands for the Non-Ferrous Industries. Alfred B. Searle. *Metal Industry*, London, Vol. 46, Jan. 11, 1935, pages 75-77, The non-ferrous industries, unlike the ferrous industries, do not demand the highest refractory material for crucibles but rather that the crucible have a high thermal conductivity and be able to withstand sudden changes in temperature. Refractory materials for this type of work are abundant in Nature and require little preparation. The tendency is toward a greater use of refractory cements and monolithic linings are increasing in popularity. For metals and alloys of high melting points, electrically fused refractory materials are being more generally used. It is pointed out that the use of thermostatic control of furnaces has greatly increased the durability of the refractory materials used. The conclusions drawn from a limited number of investigations on foundry sands are listed. The use of synthetic sands has greatly increased. See also *Metals & Alloys*, Vol. 5, June, 1934, page MA262. HBG (6)

Application of Induction Heating in Automotive Production. E. L. Bailey. *S. A. E. Journal*, Vol. 37, Nov. 1935, pages 422-424. The use of inductive heating for baking lacquered parts at 160° F. and use for melting and heat treating steel discussed. The lacquer on thin sheet material is dried ideally in that the film is heated on the inside next to the metal and gradually dried from the inside to the outside. WB (6)

Apparatus for Raising or Lowering the Temperature of a Laboratory Furnace in a Predetermined Manner. Frank Adcock. *Journal of Scientific Instruments*, Vol. 12, Sept. 1935, pages 285-288. An essential part of the apparatus is a moving potential divider which provides a steadily increasing or decreasing e.m.f. The latter is opposed to the e.m.f. due to a controlling thermocouple in the furnace, and the resulting small current deflects a mirror galvanometer which operates a photo cell. By means of a thyratron and a small electric motor, the photo cell ultimately regulates the furnace heating current. The equipment is suitable for controlling a furnace at a distance as only 2 pairs of connecting leads are required. RAW (6)

The Development of Convection Heating Equipment. *Industrial Heating*, Vol. 2, Sept. 1935, pages 476-492; Oct. 1935, pages 501-502; Nov. 1935, pages 669-670. The advantages to be derived from moving the air in furnaces and ovens are explained, applications of the principle in heat treating furnaces, equipment of batch-type furnaces, fans, exhausters, and for material handling are described in detail. Ha (6)

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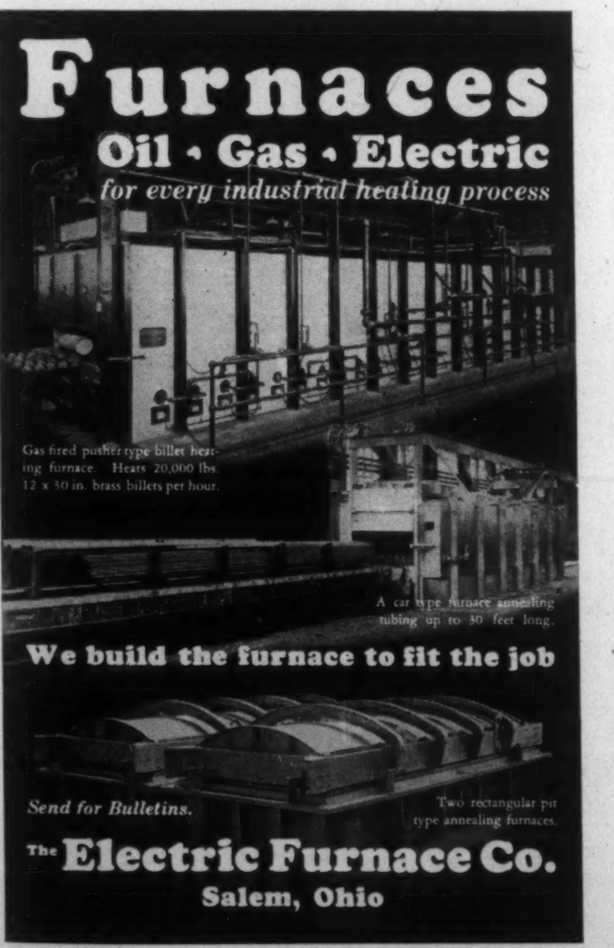
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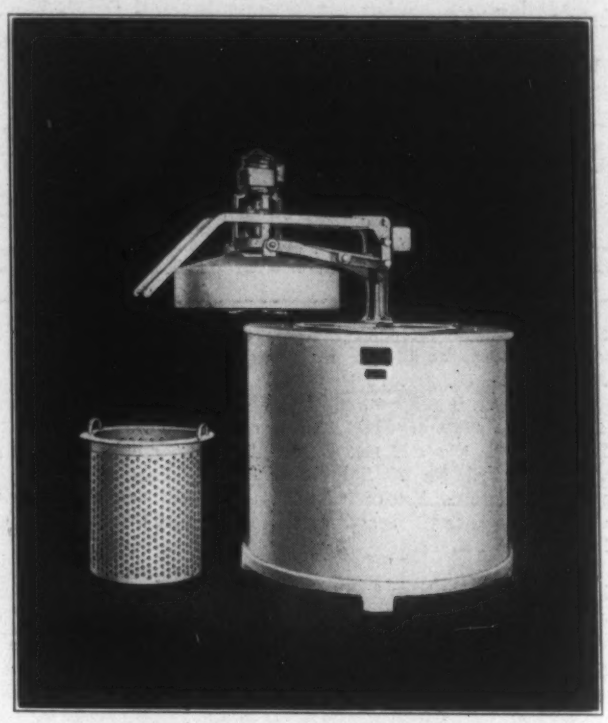

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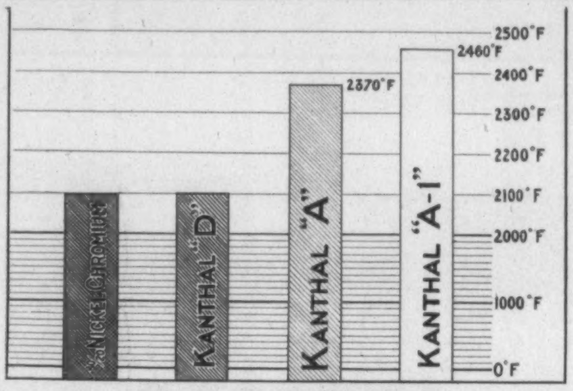

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New Design in Automatic Mechanical Gas Producers. A. E. Gibson. *Steel,* Vol. 97, Nov. 4, 1935, pages 43-45. Describes producer with gasification rate of 6000 lbs. of bituminous coal/hr. continuously. Double reduction worm gearing is totally inclosed and has bronze worm wheels and hardened and ground worms mounted on antifriction bearings. Main gear is of 0.50% C cast steel. Supporting roller track is of 0.50% C steel, rolled from 4" x 4" section. Cor-Ten is used for all-welded, H_2O-cooled shell. Rollers supporting shell and ash-pan are of hardened tread. Top plate is H_2O-cooled and is of welded rolled steel. Coal-feed base of high Cr-Ni steel castings and cast-steel poke-hole frames are welded to top plate. Poker is of cast-Fe. MS (6)

4

Some Fundamental Considerations in Core Drying. A. H. Dierker. *Industrial Heating,* Vol. 2, Nov. 1935, pages 665-667. It is explained how by analyzing the heat conditions encountered in core drying and taking into account the thermal properties of the materials involved, a saving in time and heating energy may be obtained and a more appropriate drying arrangement found. Ha (6)

5

Induction Heating at Low Temperatures. E. L. Bailey. *Electrical Engineering,* Vol. 54, Nov. 1935, pages 1210-1212. Inductively heating thin iron parts for drying coatings and for similar processes by using frequencies of 200 to 400/sec. has proved to be economical, giving low maintenance costs, cleanliness and reduced processing time. Temperature-time curves at various frequencies and currents are reproduced, arrangements described, and some operating data are given. Ha (6)

Recent Developments in Electric Furnaces for Non-Ferrous Metals. A. G. Robiette. *Metal Industry,* London, Vol. 46, Mar. 29, 1935, pages 355-357; Apr. 5, 1935, pages 383-385, 388. Paper read before the Scottish Section of the Institute of Metals on Feb. 11, 1935. An outline of the progress with developments of the past five years. Factors that apparently hinder the use of electric furnaces for production of tough pitch Cu are that this is usually produced in large quantities and that time is a factor. The resistance furnace for Pb and Sn-base bearing metals, Zn for die-casting and Al alloys is discussed and its advantages indicated. In considering the various types of furnaces for heat-treatment, consideration is given to the use of forced atmosphere circulation furnaces for low-temperature treatments, to the recent tendency toward continuous or mechanized methods, and to the annealing of metals in controlled atmospheres to preclude oxidation. Different methods of conveying are mentioned. Discussion of annealing in controlled atmospheres included the difficulties encountered, sources of production and effect of impurities. Economies resulting from this type of anneal include, in addition to cost of pickling, the metal losses saved, the elimination of buffing and polishing, the corrosive effects of acid fumes, the additional time saved, the storage space involved and the additional cost of handling. Another development is Cu or brass brazing in a controlled atmosphere which makes possible the use of light pressings where formerly heavier castings or forgings were necessary. HBG (6)

Modern Equipment for Crucible Melting. Richard H. Stone. *Metal Industry,* London, Vol. 46, June 21, 1935, pages 671-673. See *Metals & Alloys,* Vol. 6, July 1935, page MA 284R/6. HBG (6)

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7. JOINING

■ 7a. Soldering & Brazing ■

C. H. CHATFIELD, SECTION EDITOR

Cast Iron to Monel. W. P. Durglund. *Welding Journal,* N. Y., Vol. 14, Aug. 1935, page 23. A cast Fe plug was welded into bottom of Monel tank, to contain alkali, by means of cast Fe welding rod and bronze welding technique. Fusion of cast Fe plug with welding rod was effected and welding rod material sweated to the Monel with the use of a brazing flux. WB (7a)

Soldering Lead Cable Electrically. *Bell Laboratories Record,* Vol. 14, Oct. 1935, page 65. For repairing cuts and lighter defects in the lead sheath of aerial cable the sheath is connected to a little storage battery, the other electrode is a Cu plated C rod which is held against the wire solder heating it up until it flows into the affected spot. About 100 amp. are used. Ha (7a)

The Soldering of Aluminum. Harold Silman. *Metal Industry,* London, Vol. 46, Feb. 22, 1935, page 218. There are 2 methods that are applicable in practically all cases except where there is risk of corrosion. (1) High temperature soldering, using an alloy of approx. 70-95 Al, combined with Cu, Ni, Mn, Zn, Sn, Si, etc., which is done at a temperature near the melting point of Al. The neutral flame of the blow-pipe is necessary. (2) Low temperature soldering, using a high Zn or Sn-base, with little or no Al, preferably containing 2-2.5% Cu, and possibly 1% Pb, is done at 250°-420° C. The requirements of a good flux are mentioned and an example is given. Several low temperature solders are mentioned. HBG (7a)

Metals Are Brazed in Controlled Atmosphere Electric Furnaces. H. M. Webber. *Steel,* Vol. 97, Aug. 12, 1935, pages 30-33; Aug. 26, 1935, pages 36-38, 50. Paper read before tri-chapter meeting of Cincinnati, Columbus and Dayton chapters of American Society for Metals, Apr. 15, 1935. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 401L/10. MS (7a)

Special Furnace Atmospheres for Heat Treating and Brazing. C. L. West. *Industrial Heating,* Vol. 2, Sept. 1935, pages 499-502, 509-510. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 401L/8. Ha (7a)

Soft Solders. A. H. Falk. *Bell Laboratories Record,* Vol. 14, Nov. 1935, pages 89-93. A list of soft solders consisting of Pb-Sn alloys and of Ag-Cu-Zn solders with suitable fluxes as they are used in telephone work is compiled. Ha (7a)

Solder. Edited by D. J. Macnaughtan & Ernest S. Hedges. *Technical Publications of the International Tin Research & Development Council, Bulletin* No. 2, Sept. 1935, 54 pages. A comprehensive treatment of Sn-Pb solder is given in an interesting non-technical style. It is designed to show the wide fields of application of solder, the methods of its use, and the way in which these methods have been adapted to present high speed production needs. 53 diagrams and illustrations are given, most of them showing operations, products or soldering machinery from British plants. Separate sections are devoted to methods of soft soldering, soldering machines for cans and boxes, solder in the development and manufacture of the internal-combustion engine radiator, soldered joints in automatic telephone exchanges, and general uses of solder. A rather extensive bibliography and an historical note on solder are also included. BWG (7a)

■ 7b. Welding & Cutting ■

E. V. DAVID, SECTION EDITOR

Oxy-Acetylene Welding Practice and Technique. C. G. Bainbridge. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 7-18; *Welding Journal,* N. Y., Vol. 14, July 1935, pages 18-22. Gives details for "leftward" and "rightward" oxy-acetylene welding. JLG + WB (7b)

Improvements in Manipulative Procedure in Oxy-Acetylene Welding. C. S. Milne & H. Inman. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 133-137. The method of producing oxy-acetylene welds favored in the early days of the process has not been found to be the best. Details of making good oxy-acetylene welds are discussed. JLG (7b)

Welding in the Aeronautical Industry. J. B. Johnson. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 433-441; *Welding Journal,* N. Y., Vol. 14, Aug. 1935, pages 14-18. Discusses use of welding in making American planes. Oxy-acetylene welding is generally used. Structural members are made of Cr-Mo steel. Spot welding is used for stainless steel and Al alloys. JLG + WB (7b)

The Technical Training of Welders. Douglas H. Ingall & D. D. Stockley. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 817-823. Discusses training in England and outlines proposed welding school. JLG (7b)

Cored Electrodes: Their Manufacture, Properties and Use. Franz Leitner. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 427-435. Discusses advantages and disadvantages of bare and covered electrodes and then shows where cored electrodes are superior to the other types. Cites successful use of cored electrodes on large jobs in Europe. JLG (7b)

Procedure Handbook of Arc Welding Design and Practice. Third Edition. Lincoln Electric Co., Cleveland, 1935. Fabrikoid, 5¾ x 9 inches, 596 pages. Price $1.50.

The revised edition is some 140 pages larger than the preceding one. It is divided into 8 principal sections which deal with an important phase of arc welding. The text is written in a simple, concise manner. Practically every use and application of arc welding is covered.

New features added to this edition include the following: American Welding Society Specifications for filler metal; method of determining the amount of current carried by the electrode; procedures; speeds and costs for making all types of welds in sheet metal; A.S.M.E. Boiler Code Requirements for butt welds in heavy plate; hard facing of ferrous metals; examples of redesigning for arc welding; use of arc welding in making and repairing cutting tools and dies; speed of welding oil and gas pipe lines, etc.

While this book is published by a manufacturer of welding equipment and materials, it is not mere propaganda for the manufacturer. In the back part of the book, a dozen pages are devoted to the company's products.

Richard Rimbach (7b) -B-

Down to the Sea with Welding. A. F. Davis. *Industry & Welding,* Vol. 7, Sept. 1935, pages 26-27. Describes welded manufacture of diving suits and diving bells. Ha (7b)

Welded Piping in an Air-conditioned Department Store. W. F. Barrow. *Welding Engineer,* Vol. 20, Sept. 1935, pages 37-39. Description of installation and of welding work done in it. Ha (7b)

Resistance Welding and the Metal Vacuum Tube. R. J. Bondley. *Product Engineering,* Vol. 6, Oct. 1935, pages 374-375. Vacuum tubes are now made of metal of expansion characteristics substantially the same as glass to make a strain-free seal between the two materials. Manufacture by welding is described. Ha (7b)

Repair of Copper Fire Boxes of Locomotive According to Modern Points of View (Wiederherstellung von kupfernen Lokomotivfeuerbüchsen nach neuzeitlichen Gesichtspunkten). H. Cramer. *Autogene Metallbearbeitung,* Vol. 28, Sept. 1, 1935, pages 260-262. Although promising experiments have been made by the German State Railways with locomotive fire boxes of steel they have not yet replaced the fire boxes of Cu. All joints are welded except for the fire hole and bottom ring which are riveted. Leakage between the Cu stay bolts and wall are avoided by fusion or electric welding. Improvements in welding procedure are described. Ha (7b)

Welding (Soldadura). E. Jimeno, A. Modolell & F. R. Morral. *Anales de la Sociedad Española de Fisica y Quimica,* Vol. 33, July-Aug. 1935, pages 696-708. A metallographic study, macro and micro, is made of 3 representative electric arc welded samples, pointing out the structure and the hardness of the various weld regions. A few radiographs are given which show the presence of defects, and thus the desirability of careful control of welds. It is recommended that the Spanish scientific worker acquire a keener interest in the problems inherent in the modern technical methods. Bibliography. FRM (7b)

What is the Arcronograph? *Industry & Welding,* Vol. 6, Apr. 1935, pages 11-13, 34. The instrument records the manner in which the successive melting of the electrode, formation of the drop and its deposition on the preheated work proceed. It permits judging whether the current is "just right" to supply the correct heat to make the process continuous and uniform to obtain a satisfactory weld. Ha (7b)

A List of Fundamental Research Problems in Welding. List of Researchers and Researches. *Welding Journal,* N. Y., Supplement, Vol. 14, Aug. 1935, pages 3-10, 11-13. Presentation of the problems to be investigated with comments and discussion. The second list gives the name of investigator and his affiliation. WB (7b)

Applications of Resistance Welding. P. R. Dunn. *Electrical Review,* Vol. 117, Aug. 9, 1935, pages 177-178. Describes numerous applications. Butt welding is used for joining wire for redrawing; welding water, steam, and refrigerator coils; repairing boiler-tubes; welding flanges to pipes; joining cutting portions of tools to C-steel shanks; and fabrication of machine parts, band-saws, refrigerator cabinets, automobile bodies, chains, and torque tubes. Spot welding is employed in the manufacture of refrigerator trays; lamp-shades; wire guards; radio parts; machine parts; and automobile bodies, fenders, brake-shoes, and shock-absorber brackets. Seam welding is used in manufacture of drums, kettles, and automobile wheels. Ms (7b)

Tools Saved by Using New Electrode. A. F. Davis. *Industry & Welding,* Vol. 6, May 1935, pages 6-8. Rebuilding of tool edges by a special electrode "Toolweld" (composition not given) is described. Ha (7b)

Carbon Arc Welding of Galvanized Sheets. L. W. Ericson. *Industry & Welding,* Vol. 6, Feb. 1935, pages 24-25. Most satisfactory results in welding galvanized sheets without impairing the galvanizing are obtained with arc welding using a carbon arc and an "Everdur" electrode coated with a composition of Sn. It is rather a brazing process as very little heat is applied to the galvanized iron. The Everdur rod is of a corrosion resisting material so that the weld has a high resistance to rusting and corrosion by most of the commercially used acids. D.c. is best used with the electrode of 5/32" or 5/16" diam. as negative. Ha (7b)

The Welding Symposium. *Welding Journal,* British, Vol. 32, May 1935, pages 136-137. The subjects and objects of the papers presented at the Iron & Steel Institute symposium are summarized. The individual papers are abstracted elsewhere in *Metals & Alloys.* WB (7b)

Arc Welding Bronze and Cast Steel Water Wheel Runners. R. F. Miller. *Industry & Welding*, Vol. 7, Sept. 1935, pages 28-30. See "Repairing Water Wheel Runners by Arc Welding," *Metals & Alloys*, Vol. 6, Aug. 1935, page MA 327L/4. Ha (7b)

Caisson Construction for the San Francisco-Oakland Bay Bridge. B. J. Osborne. *Welder*, Vol. 7, Aug. 1935, pages 642-646, 653. Describes the welding procedures and welded constructions. See also "Steel Fitted to New Method of Caisson Construction," *Metals & Alloys*, Vol. 5, July 1934, page MA 372. Ha (7b)

Welding for the Steel Foundry Industry. V. G. Pearson. *Symposium on Welding of Iron & Steel*, Organized by Iron & Steel Institute, May 2-3, 1935, 6 pages; *Welding Journal*, Vol. 32, Aug. 1935, pages 241-244. Metal arc welding is recommended for repairing steel castings. Good materials and reliable operators should be used. JLG + WB (7b)

A 700 Meter Landing Pier Without Bolts and Rivets (700 Meter lange Landungsbrücke ohne Nieten und Bolzen). A. Lion. *Schiffbau, Schiffahrt & Hafenbau*, Vol. 36, July 1, 1935, pages 210-212. Describes in detail the construction and erection by welding of a landing bridge recently completed at Davenport, Cal. WH (7b)

A Consideration of Qualification Tests for "Class 2" Arc Welding. R. B. Lincoln. *Welding Engineer*, Vol. 20, Sept. 1935, pages 68-70. Proper preparation of test specimens and avoiding of failures is discussed; proper procedures are illustrated. Ha (7b)

Welding of Stainless Steels (La soudure des aciers inoxydables). A. Leroy. *Métaux*, Vol. 9, Oct. 1934, pages 460-470. 22 references. The martensitic and ferritic steels are brittle after welding and therefore they have to be subjected to heat treatment in order to eliminate this property and also to refine the structure. The austenitic steels develop intergranular corrosion. Addition of Ti, Cb, W or Mo prevents this type of corrosion. 3 types of welding flames are considered; single torch, torch with additional flame and 2 torches. For one torch it is recommended to use 70 liters acetylene/hr./mm. thickness of weld, with 2 torches to use 20 liters acetylene/torch/hr./mm. weld thickness. GTM (7b)

Arc Welding in the Building Industry. J. F. Lincoln. *Industrial & Engineering Chemistry*, Vol. 27, Oct. 1935, pages 1139-1140. Uses and advantages of arc welding are reviewed. MEH (7b)

Gas Cutting, the Companion to all Welding. James Murray. *Industry & Welding*, Vol. 7, Aug. 1935, pages 14-16, 39. Examples of pinions, bearing plates, and other shapes cut with the flame illustrate savings made by fabricated instead of cast machinery. Ha (7b)

Fusion Welding of Nickel and Its Alloys (La Soudure Autogène du Nickel et de ses Alliages). P. Modro. *Métaux et Machines*, Vol. 19, Aug.-Sept. 1935, pages 279-280. Studies effects of S and Mg in the metal and gives details on process, power of torch to be used, etc. Typical applications are illustrated. FR (7b)

Chemical and Metallographic Study of Welds (Étude chimique et métallographic des soudures). Maurice Michaud. *Métaux*, Vol. 10, Apr. 1935, pages 101-111. A digest of papers on welding presented at the Congress in Rome. The following papers were discussed: Contribution to study of welds of austenitic Mn steels, by A. Portevin and D. Seferian; Metallographic and mechanical characteristics of arc welding, by J. Musatti and A. Reggiori; New microscopic researches on welded joints by means of movie film, by Prof. C. F. Keel; corrosion resistance of welds, by Andre Leroy and Maurice Bonnot; Research on the resistance of welds to acid attack, by G. Fauser; Contribution to the study of fixation of phosphorus from the impure acetylene to the steel welds, by D. Seferian; Elimination of hard spots and of sulphides in the welds of cast iron, by A. Baillon. GTM (7b)

Welding Aluminum with the Metallic Arc. Arnold Meyer, Jr. *Welding Engineer*, Vol. 20, Sept. 1935, pages 29-31. Characteristic differences in welding Al and steel are explained. Advantages of arc welding for Al are seen in the fact that heat stresses produced are not high, as the heat is concentrated in such a manner that little warpage occurs in spite of the high expansion coefficient and low modulus of elasticity. A high joint efficiency can be obtained as, due to the heat concentration, the material is not held at the recrystallization temperature long enough to complete annealing and the zone of annealed metal is quite narrow. Cleanliness and dry electrodes are imperative, presence of Si improves the properties of weld metal. Examples and microphotographs of welds are shown. Ha (7b)

Fundamental Data on Resistance Welding. A. M. McFarland. *Welding Engineer*, Vol. 20, Sept. 1935, pages 40-43. Speed and cost of welding of various electric resistance processes as dependent on thickness of weld are discussed and spot welding data containing cost per 1000 spots, energy consumed, welding load and transformer capacity are given in a table. Recent developments of equipment and control are reviewed. Ha (7b)

Arc Welded Footbridge. E. S. Needham. *Welder*, Vol. 7, Sept. 1935, pages 677-679. Design and welding data of a 39′ 6″ span are given. Ha (7b)

Thermal Study of Welds (Etude Thermique des Soudures). A. Portevin & D. Seferian. *Chaleur et Industrie*, Vol. 16, Sept. 1935, pages 409-424. Points out importance of heat distribution on (1) structure and therefore mechanical properties and (2) physical effects (distortion, strains, cracks). Knowledge of the 2 factors, maximum temperature reached and maximum cooling speed, allows solution of structural problems by means of characteristic hardening curves. Reviews theoretical studies which have been made previously. Present study is divided as follows: (1) Theoretical study of heat distribution in the case of fixed localised melting on boundless bar or plates, then the case of moving melting spot is discussed. Curves drawn from computations show general trend of phenomena. (2) Description of experimental results obtained by authors. Difference between theory and practice is due to approximations made for resolving complex differential equations given by theory. (3) Conclusions point out influence of welding process, nature of metal (heat conductivity) and size and shape of pieces. Predictions are verified by experiment. FR (7b)

Some Results Concerning the Variation of Chemical Composition in the Gas-Welding of Ordinary Steels. Albert M. Portevin & A. Leroy. *Welding Journal*, N. Y., Vol. 14, Aug. 1935, pages 9-11. In gas welding without flux and in bare arc welding the action of the atmosphere is predominant in the absorption of O_2, N_2 and the loss of oxidizable elements as is the case in steel converter. With protective flux the resistance to N_2 absorption is predominant and there is a chemical exchange between the two melted phases, metallic and slag as is the case in the open hearth furnace. Laws of physical chemistry permit anticipation of direction of the chemical changes but it is not possible to predict the extent or magnitude due to the complexity of the reaction. Preliminary results are given for variation of C, Si, Mn in gas welding apart from variation in S, P, O_2, N_2. Factors are size of flame, its control, method of welding, size of weld, diam. of rod, thermal properties of base metal, etc. Preliminary results of chemical analysis of metal strips and beads deposited on cold thick plates using weld metal of same composition as plate. Results are given for 0-1.0 C, 0-2.0 Si, 0-2.0 Mn with S and P less than .02 and are put into graphic form. Si exerts protective effect on C oxidation but none on Mn losses. Mn and Si losses are shown. WB (7b)

Welding Practices in the Modern Railroad Shop. R. R. Royal. *Welding Engineer*, Vol. 20, Sept. 1935, pages 50-56. Describes manual and automatic welding methods and equipment used. Ha (7b)

Transition Structures on Welding with Austenitic Welding Rod (Uebergangsgefüge bei der Schmelzschweissung mit austenitischen Zusatzwerkstoffen). F. Rapatz & W. Hummitzsch. *Archiv für das Eisenhüttenwesen*, Vol. 8, June 1935, pages 555-556. Austenitic welding rods produce ductile welds not subject to air hardening on cooling from the welding heat, the latter being especially advantageous on welding a hardenable steel. Martensite forms in the transition between weld and base metal—mixed with ferrite in lower C steel and with austenite in higher C steel. Ni-austenite produces a tougher transition zone than Mn austenite, presumably because Ni, with its lower diffusion rate produces thinner martensite layers than Mn. Another drawback of Mn is the greater sensitivity of Mn martensite to overheating. Cr and Mo improve the weldability, but have less effect on the structure than Ni and Mn. In welds made with austenitic Mn steel rods, cracks readily form because of the high sensitivity of Mn martensite to overheating and the high coefficient of expansion of Mn-austenite. Low C contents in both rod and base metal increase the ductility of the weld. By means of austenitic welding rods, especially of Ni and Ni-Cr steel austenitic 12% Mn steel and pearlitic high C steels can be successfully welded. SE (7b)

Electrode Coatings in Arc Welds (I rivestimenti per elettrodi nella saldatura ad arco). A. Regé. *La Metallurgia Italiana*, Vol. 27, July 1935, pages 493-503. A summary of arc welding technique. Most types of steel can be welded successfully by choosing the proper electrode coating. Below are the electrodes and coatings recommended for various steels.

	Core			Coating								
Metal to be Welded	C%	Mn%	Si%	Talc or Asbestos	Pumice	Fe_2O_3-FeO Fe_3O_4-MnO_2	Na_2SiO_3 36 Be	Graphite	Fe-Mn 75%	Fe-Si 95%	NiO	Cr_2O_3
Soft iron	0.05	0.40	0.015	13	33	13	32	2	5	2	—	—
Steel—Semi-hard or hard	0.10	0.40	0.03	10	30	13	30	5	9	3	—	—
C—Steel	0.15	0.60	0.015	10	20	18	30	3	20	9	—	—
Ni—Steel	Ni—Steel			9	30	11	30	5	9	3	3	—
Cr-Ni—Steel	Cr-Ni—Steel			8	28	10	30	5	10	3	3	2
Mn—Steel	1.3	13	0.04	13	33	13	32	2	5	2	—	—
Stainless steel, high Cr or Cr alloy	<0.2	Stainless steel (high Cr)		8	28	10	32	2	15	5	—	5
Stainless steel Cr-Ni	<0.15	Stainless steel (Cr-Ni)		7	23	10	31	3	10	3	8	5
Tough Steels	C=0.15; Mn=0.4 Si=0.3; Cr=25; Ni = 20			7	23	10	31	3	10	3	8	5
Cast-iron—cold	C = 0.10; Mn = 1.0; Si = 0.01 Ni=68.0; Cu=30			10	35	10	30	2	5	8	—	—
Cast-iron—hot	Annealed cast - iron			5	30	10	33	8	10	4	—	—

AWC (7b)

Welded Metallic Frames for Building the Railway Station at Geneva (L'essature Metallique Soudée de la Gare de Genève). R. Salelles. *Revue de la Soudure Autogène*, Vol. 27, Aug. 1935, pages 8-11. Descriptive article giving shape of members, process adopted, testing and properties of welds. FR (7b)

Welding Malleable Iron and Cultivator Shovels. V. L. Sage. *Industry & Welding*, Vol. 6, June 1935, pages 18-19. Difference in structure of cast Fe, steel and malleable iron is explained and procedures of repairing by welding described. Ha (7b)

Welding Truck and Tractor Frames. V. L. Sage. *Industry & Welding*, Vol. 6, May 1935, pages 12-13. Description of preparation of work and procedure for fusion welding. Ha (7b)

Difficult Casting Converted to Plate. L. C. Surato. *Industry & Welding*, Vol. 6, May 1935, pages 22-24. A complicated piece was made up by welding plates and profiles together instead of casting. Its weight was 4300 instead of 6200 lbs. and 12 days were saved in finishing. Ha (7b)

Welding in the Shipbuilding Industry. W. Strelow. *Transactions of the Institute of Marine Engineers*, Vol. 47, July 1935, pages 163-166. This paper was presented under the participation of the Institute of Marine Engineers in a "Symposium on the Welding of Iron and Steel" on May 2nd, 1935, organized by the Iron & Steel Institute, and traces the evolution of arc welding in German shipyards up to the present time. Great stress is laid on the problem of bare vs. coated electrodes. WH (7b)

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Welding Refrigerators. W. H. Gibb. *Welding Journal,* N. Y., Vol. 14, Aug. 1935, page 13. Continuous, pressure-tight seam welds and intermittent seam welds used in fabricating evaporator parts for refrigeration. WB (7b)

Influence of the Shape on Mechanical Properties of Welded Joints (Influence de la Forme sur les Propriétés des Assemblages Soudés). H. Gerbeaux. *Revue de la Soudure Autogène,* Vol. 23, Sept. 1935, pages 3-11. Comprehensive study under following heads: Gas holes and inclusions, shape of welds, butt welds, angle welds, transverse welds, longitudinal welds, complex joints. Author concludes that butt welds when well made represent an ideal joint and that angle welds even when thoroughly made involve important peaks in strains. FR (7b)

Direct Measurement of Contraction of Butt Welds. O. M. Harrelson & Searcy B. Slack. *Welding Journal,* N. Y., Vol. 14, Aug. 1935, pages 21-22. Measurement was made on specially prepared sample during welding and on cooling from weld heat of arc and gas welds with bare wire. Contraction indicated for arc welds is .024-.054" per sample for plates ¼-1¼" thick, for gas welds .052-.086" for plates ¼-¾" thick. No very great accuracy is claimed for the test results. An hypothesis is advanced that the amount of contraction is proportional to the size of the pool of molten metal in the arc crater or under the flame of the torch, the larger the pool the greater the contraction. WB (7b)

Practical Field Testing and Instruction of Welders. D. O. Ferguson. *Industry & Welding,* Vol. 6, May 1935, pages 14-16; June 1935, pages 20-23; July 1935, pages 10-12, 34, 40. Methods of making field tests of pipe-welding and instructing the welders are discussed at great length. Ha (7b)

Fabricating Tool Equipment and Machine Parts by the Torch Cut and Weld Method. P. H. Danly. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 28-31; *Industry & Welding,* Vol. 7, Oct. 1935, pages 16-19. General discussion of the advantages gained in designing and building tools by this method. Among them are greater freedom from limitations in materials and manufacturing processes, easier alterations, reduced weight and greater rigidity. WB + Ha (7b)

The Welding of Wrought Iron. J. E. Fletcher. *Symposium on Welding of Iron & Steel,* Organized by Iron & Steel Institute, May 2-3, 1935, 8 pages. Gives data on mechanical properties of wrought iron and on bundles rolled t different diameters. Perfect welds are formed on working the bundled material. See also *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 326R/2. JLG (7b)

New Developments in Oil Casing Welding. Owen C. Jones. *Industry & Welding,* Vol. 7, Oct. 1935, pages 27-29. Present practice and testing methods are described. Ha (7b)

Acetylene Welding of Electrolytic Copper (Azetylenschweissung von Elektrolytkupfer). L. Hunsicker. *Autogene Metallbearbeitung,* Vol. 38, Sept. 15, 1935, pages 273-282; Oct. 1, 1935, pages 289-297. Cu of commercial grades was subjected to different welding methods and the crystal structure, tensile properties and corrosion resistance to acetic acid investigated. The tensile test results did not differ whether the progressive or retrogressive welding method was applied. The best results with regard to mechanical properties and structure were obtained with hammered X-welds; the hammered V-weld also showed good results. Corrosion can sometimes occur in the seam as the deposited material which is usually an alloy of Cu, may have a different potential from the base material so that a local element is formed. The electrolytic action can be reinforced by local accumulations of baser substances in the seam; the potentials occurring in acetic acid in a weld for which a Ni-containing welding rod was used were measured. Numerous tests of mechanical properties, structural changes and corrosion conditions are given. Ha (7b)

Resistance Welding Important in Development of All-Metal Radio Tubes. *Iron Age,* Vol. 136, Aug. 15, 1935, pages 35. Brief illustrated outline of the method of assembling all-metal radio tubes and importance of resistance welding in their production. Thomas-Gibbs Electric Welding Co. equipment is used. VSP (7b)

Welding Cable Designed for Severe Wear. *Iron Age,* Vol. 136, Oct. 10, 1935, page 19. Describes welding cable developed by Lincoln Electric Co. and known as Realwear. Consists of fine tinned Cu wire laid in ropes and stranded. Individual ropes are alternated in succession as regards directions of lay to prevent distortion in applications of severe usage. VSP (7b)

Welding the "Clad" Steels. *Industry & Welding,* Vol. 7, Sept. 1935, pages 61-64. Procedure is described and illustrated. Ha (7b)

On the Hardness Distribution in Electrically and Thermit Welded Seams (Über die Härteverteilung in den elektrisch und thermitisch geschweissten Nähten). E. Cotel. *Montanistische Rundschau,* Vol. 27, Sept. 16, 1935, pages 5-7. Samples of welded rails were machined and polished on the upper surface and tested for Brinell hardness at 4 different points. In arc welded rails one test was made in the center of the weld, one in the intermediate zone, one 10 mm. from this zone, and the fourth 20 mm. from the intermediate zone. In thermit welded rails where the intermediate zone is so much wider than in the arc welded rails, 2 readings were taken in this zone, with one reading in the center of the weld and a fourth in the rail itself. BHS (7b)

Welding of Low Alloy Steels. J. C. Holmberg. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 8-10. The welding of Cromansil, Cor-ten, Man-ten, and Sil-ten is discussed to show that higher physical properties are not necessarily associated with brittle material. There is more difficulty in duplicating the composition of the parent metal in the weld but with Mo it is possible to get up to 1% into the weld by means of the rod coating. Ni is also easily put into the weld from the rod while other additions to the rod such as V and Ti are easily burned out. Ni steels are considered to be most susceptible to flakes or thermal checking although other steels are affected also in forging. WB (7b)

Welded Equipment for the Food Industries. J. Hinde. *Welder,* Vol. 7, Sept. 1935, pages 696-698. Mild and stainless steels, Al, Ni alloys and Cu are used in the canning and preserving industries, and they are either galvanized, glass-enamel lined or sprayed with some suitable coating. Welding procedures employed are described. Ha (7b)

Developments in Spot Welding. *Mechanical World & Engineering Record*, Vol. 48, July 26, 1935, pages 84-85. Automatic relays and contactors applied to spot welding machines make the time of current application independent of the judgment of the operator. When welding non-ferrous metals such as brass or Al, the color change on the upper surface is insufficient to give a reliable indication whether the weld is completed or not. On heavy material, faulty welds may result if the surfaces are not flat and the pressure applied by a pedal is not sufficient to pull them into close contact. Electrical wiring diagram of automatic control of spot welding machine is reproduced. WH (7b)

Water-Gas Welded Drums for Marine Boilers. *Marine Engineer*, Vol. 58, July 1935, page 178. Discusses the water-gas roller-lap welded type of water-boiler drums made by the narrow measure Thyssen processes for the new North German Lloyd liner "Scharnhorst." The prejudices against this type of boiler drum are rejected and the most arduous marine conditions for the boiler are pointed out. The strength of the weld is 96% of that of the material which has a tensile strength of 26-32 tons/in.^{2} Some of the boiler drums are seamless, hot radial-rolled drums made from a hollow billet in a special form of expanding radial roller mill. The whole process of manufacture is completed in one heat. The traditional solid forged drum is more expensive. The boiler pressure is 710 lbs./in.^{2} and the final steam temperature 878° F. WH (7b)

Terms Used in Electric Welding Practice. *Machinery*, N. Y., Vol. 42, Oct. 1935, pages 110-111. A compilation of the definitions of terms used in electric resistance and arc welding practice. Ha (7b)

Welding in Ship Construction. *Journal of Commerce, Shipbuilding & Engineering Edition*, July 11, 1935, pages 1-2. An examination and a comparison is made of the oxy-acetylene and the electric-arc systems of welding for ship construction, and it is considered that improvements in the technique of the former, difficulties resulting from the oxy-acetylene cutting of plates, prior to electric welding, and the greater latitude allowed in the setting up of the work in oxy-acetylene welding makes this process as satisfactory as arc welding, and at the same time considerably cheaper. JWD (7b)

Oxy-Acetylene Methods of Welding for Shipwork. *Journal of Commerce, Shipbuilding & Engineering Edition*, Sept. 5, 1935, page 1. A review of the application of oxy-acetylene welding in shipbuilding and the improvements in technique which have taken place. Special reference is made to the introduction of the multi-flame blowpipe and the modern rightward method of welding, where there is no cessation of the steady motion of flame welding. JWD (7b)

Welding Speeds Up Line Pipe Construction. *Iron Age*, Vol. 136, Sept. 12, 1935, pages 24-27. Describes the construction of 89 mile oil pipe line in 72 days by the General Pipe Line Co., Los Angeles, a subsidiary of General Petroleum Corp. The pipe used was grade B seamless steel pipe, larger portion weighing 34 lbs./ft., with 0.307″ thickness tested to 950 lbs. The line traverses Tehachapi mountain, through Sepulveda tunnel. Material was supplied by the National Tube Co., Youngstown Sheet & Tube Co. and Spang-Chalfant Co. VSP (7b)

Improved Fabrication of 18-8 Chromium Steels. *Oxy-Acetylene Tips*, Vol. 14, Oct. 1935, pages 221-225. The tendency of 18-8 steels to intergranular corrosion in the base metal after welding was found to be eliminated when using welding rods of stainless steel containing Ti or Cb. The latter is more advantageous as it is not burned out of the rod to any extent during welding. Cb also counteracts the slight C pick-up sometimes observed during welding. The welding procedure used with these rods is the same as used in welding ordinary steel, but the flame should be adjusted to give a neutral condition in which equal volumes of O_2 and C_2H_2 are consumed. Use of Cromaloy flux is strongly recommended. Ha (7b)

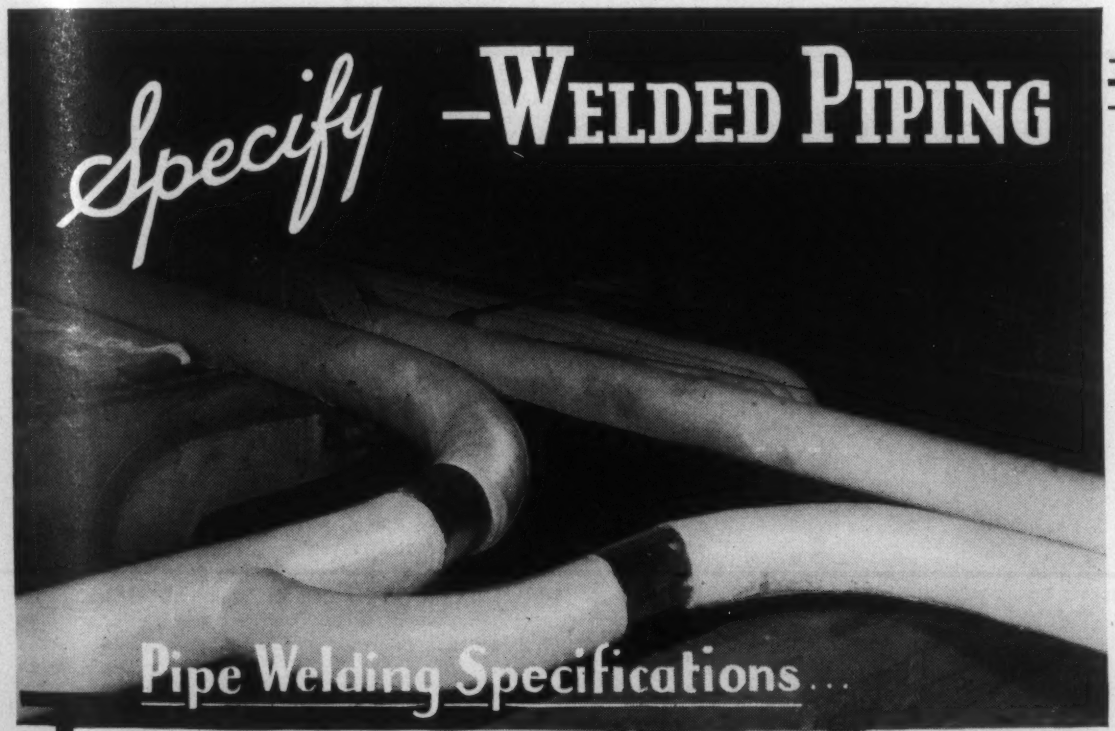
Welding Aluminum Alloys. *Industry & Welding*, Vol. 7, Sept. 1935, pages 57-60. Compositions of wrought Al and Al sand cast alloys, preparation of work and procedure in welding are described and illustrated. Ha (7b)

Fabrication of Electrical Machinery. *Electrical Review*, Vol. 117, Oct. 4, 1935, pages 439-440. Fabrication of electrical machinery from steel sections by welding has advantage of reducing weight and cost of manufacture as compared with use of castings. There are, however, instances where method is unsuitable. Welded construction is more liable to distortion and bending, if vibration is likely to be set up in service. Small machine air gaps lead to bending of frame if construction is too light in cross-section. In a fabricated machine mass of material heats up more quickly and shell temperatures are usually higher for short periods than in cast machines. Fabricated d.c. machines have less space for the field coils, as the diam. of the shell restricts the physical dimensions. To obtain the output for the same diam. and length of armature, Cu in fabricated machine must be put to its fullest use. MS (7b)

Hard-Surfacing Dies and Punches. J. B. Ames. *Welding Engineer*, Vol. 20, Oct. 1935, pages 19-20. The procedures for hard-surfacing with the metallic arc by using slag-producing rods are discussed. Cooling should be done in air, not in water, and the arc should be broken gradually. Ha (7b)

Looking Through Welds. M. B. Adrian. *Welding Journal*, N. Y., Vol. 14, Aug. 1935, pages 12-13. Discussion of X-ray inspection of castings on production conveyor by means of fluoroscope. Inspector can determine whether and where castings can be welded for repair. WB (7b)

Problem in Resistance Welding: Electrodes for Spot Welding (Un Problème de Soudure par Résistance: Les Electrodes pour la Soudure par Points). F. Fassbinder. *Revue de la Soudure Autogène*, Vol. 27, Aug. 1935, pages 5-7. Suitable alloy must have following properties: (1) high electrical conductivity at room temperature, (2) high thermal conductivity, (3) low temperature coefficient for electrical conductivity, (4) good mechanical properties at room temperature (hardness, crushing strength, resistance to wear and shock), (5) these properties must be kept fairly high at temperature up to 400°-500° C., (6) must be easily machined, (7) must not stick to pieces slightly rusted or covered with scale, (8) must be low in cost. Need of coöperation between welders and metallurgists for solving this problem is pointed out. FR (7b)



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8. FINISHING

H. S. RAWDON, SECTION EDITOR

8d. Electroplating

Defective Silver Deposits; Effect of Weighting Cements and Sulphur on Silverplating (Fehlerhafte Silberniederschläge; Einfluss von Beschwerungskitten und Schwefel auf die Versilberung). E. RAUB & K. BIHLMAIER. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 9, July 1935, pages 29-35. An exhaustive investigation was made of occasional defects in Ag deposits which cannot be ascribed to the metal plated, to the preparation of the objects, or to the bath. It was found that such defects often occur on articles which have been loaded with cements (hollow ware such as knife handles, etc.), the loading cements consisting usually of mixture of resins, asphalt, oils and brick dust. The resins and oils are partly dissolved in the alkaline bath and streaks are produced on the surfaces which make the deposit loosely adherent. The effect becomes more pronounced with increase in free KCN in the electrolyte. Current density has also an influence. Streaky, sandy deposits were obtained with 0.3 amp./dm.^{2}, lower density improved conditions but did not eliminate them entirely. An increase in bath temperature seems slightly beneficial. Very small amounts of dissolved loading agents deteriorate the deposits, and as it is very difficult to remove them from the bath it is best to make up a new bath. Wherever possible, loading should be done after Ag plating. Another defect, discolored deposit, results from presence of silver sulphide which can easily be recognized by the distinct turbidity of the bath. Chemical analysis always revealed Ag_2S also in the deposit. Usually, the KCN used for baths contains some S. The bath can easily be freed from Ag_2S by heating and filtering it. Ha (8d)

The Co-deposition of Tungsten and Iron from Aqueous Solutions. M. LESLIE HOLT. *Transactions Electrochemical Society,* Vol. 66, 1934, pages 453-460. Fe is present in the "tungsten" deposits obtained from aqueous W plating baths. Removal of Fe from the plating bath by continued use results in a "depleted" bath which can be regenerated however, by addition of very small amounts of Fe, which Fe, of course, will be present in the W deposit. (8d)

Rhenium Plating. COLIN G. FINK & P. DEREN. *Transactions Electrochemical Society,* Vol. 66, 1934, pages 471-474. Bright, hard deposits of rhenium metal were obtained from various aqueous Re solutions. Re can be deposited very rapidly and the solution has good throwing power. Plates of any desired thickness can be obtained. The plated metal is very resistant to HCl. Detailed bath formulas are given. Re can be codeposited with other metals. (8d)

The Effect of Oxidizing Agents on Nickel Deposition; Hydrogen Peroxide and Nickel Nitrate. A. W. HOTHERSALL & R. A. F. HAMMOND. *Transactions Faraday Society,* Vol. 30, Nov. 1934, pages 1079-1094. Contains bibliography. Effects on cathode efficiency, hardness, pitting, cathode potential and gas discharge at the cathode, of additions of pure H_2O_2 and $Ni(NO_3)_2$, have been determined. The action appears to be H_2 depolarization. The cathode efficiency decreases in a linear manner with increasing concentration of oxidizing agent. Nitrate was reduced to NH_3. Additions of the oxidizing agent increased the hardness and bright appearance of the deposit. With increasing additions of oxidizing agent, the amount of H_2 discharged gradually decreased to zero. With further additions, gas discharge recommenced. The action of H_2O_2 and nitrate additions in preventing pitting, appear to be identical with their effects in inhibiting gas discharge. An alternative method or preventing pitting with H_2O_2, consists in the oxidation and precipitation of iron compounds, which removes impurities by absorption. PRK (8d)

Bus Bars for Electrochemical Plants. L. C. PAN. *Transactions Electrochemical Society,* Vol. 66, 1934, pages 369-380. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 328 R9. (8d)

Adhesion of Electrolytic Copper Deposits. PIERRE A. JACQUET. *Transactions Electrochemical Society,* Vol. 66, 1934, pages 393-426. Certain hydrophilic colloids (proteins and their disintegration products) form adsorption films on metal surfaces (Cu, Ni, Fe, Pt), which materially reduce the adhesion of electrodeposits to such surfaces. On the basis of the adsorption phenomenon, a method for the determination of the degree of adhesion of electrodeposits on any basis metal has been evolved. As a rule, results are reproducible to about 10 to 20%. The measurements are limited by the distortion of the deposit, this limit being a function of its thickness. For Cu deposited on Ni, a thickness of 0.30 mm. (.012 inch) is sufficient for the study of various factors affecting the degree of adhesion of electrodeposit to basis metal. The less the mechanical strain developed in the Cu deposit, the better will it adhere to the Ni. During the operation of an acid $CuSO_4$ bath a gradual continuous change occurs in its composition. The degree of aging of the bath can be estimated from the degree of strain developed in successive deposits from the same bath. The aging of the bath has a marked effect on the adhesion of Cu to Ni. Aging appears to result from formation of the cuprous ions. For strongly adherent deposits of Cu or Ni it has been shown by 2 chemical tests, H_2S and $K_4Fe(CN)_6$, that stripping off Cu deposits leaves a residual Cu film on the Ni surface, nearly always continuous. Thus the force necessary to detach the Cu deposit from the basis metal does not correspond to the true adhesion of the deposit, but represents the shearing stress of the Cu. The true adhesion of Cu deposited from a Cu bath with a very low content of free sulphuric acid seems to be very high, but the shearing stress is relatively low. This fact might be explained by the presence of some cuprous oxide in the metal. The physical state of the basis Ni surface has a great effect on the adhesion of the electrolytic Cu. As a rule, it is better on polished surfaces than on roughened electrolytic ones. The adhesion is very low on emery-scratched surfaces. (8d)

The Electrodeposition of Ternary Alloys of Cadmium, Zinc and Tin. LAWRENCE E. STOUT & BERNARD AGRUSS. *Transactions Electrochemical Society,* Vol. 66, 1934, pages 441-452. Ternary alloys of Cd, Zn and Sn can be deposited from a solution containing the complex cyanides of Cd and Zn. Na stannate, NaOH and free NaCN. Excellent resistance to corrosion is offered by plates high in Sn. Almost without exception alloys containing Sn, even in small amounts, withstand salt spray better than deposits free from Sn. Deposition of Cd is favored over the deposition of Sn and Zn. A comparatively large concentration of Sn in the bath is required to produce an appreciable Sn content in the deposit. An increase in the Cd and Sn concentrations in the bath results in an increase of Cd and Sn in the deposit. The same is true for Zn at higher current densities but for low current density increasing the Zn concentration in the bath decreases the Zn content in the deposit. At 20° C. the Sn and Zn contents of the deposit decrease while the Cd content increases with increasing current density. At 2 amp./dm.^{2} the Sn and Zn contents of the deposit increase while the Cd content decreases with increasing temperatures. At 0.5 amp./dm.^{2} the Zn content of the deposit decreases with increasing temperature. The behavior of Sn and Cd does not change. (8d)

Theory and Practice of Chromium Plating (Theorie und Praxis der Verchromung). N. D. BIRÜKOFF, S. P. MAKARIEWA & A. A. TIMOCHIN. *Korrosion & Metallschutz,* Vol. 11, Aug. 1935, pages 172-179. A generally acceptable explanation of the mechanism of oxidation and reduction in the deposition of Cr from chromic acid solutions with additions of H_2SO_4 has not yet been advanced. New experiments were made. The facts resulting from them do not agree with the theory of Müller (*Elektrochemische Zeitschrift,* Vol. 36, 1926, page 399) as well as with the theory of Liebreich (*Elektrochemische Zeitschrift,* Vol. 27, 1921, pages 94, 252 and Vol. 29, 1923, page 208). The yield in Cr seems mainly to depend on the concentration ratio H_2SO_4/Cr^{III} (trivalent Cr), and also, on whether the Cr^{III} belongs to mono- or to bichromate. The products of cathodic reduction of CrO_3 are, apparently, unstable compounds which are gradually disintegrated by the solution with the liberation of H_2SO_4. Another important factor is the velocity ratio of the formation of Cr^{III} and crystallization of metallic Cr. In the experiments, for each molecule CrO_3 which was reduced to metallic Cr, one molecule CrO_3 was reduced to Cr^{III} and this ratio (approximately 2) affects the structure of the deposit. In general, it can be stated that deposition of Cr is possible if simultaneously with the metal a certain amount of Cr^{III} is formed in the solution at the cathode, and that the deposition of Cr becomes impossible if the transformation $Cr^{VI} \longrightarrow Cr^{III}$ is absent. 10 references. Ha (8d)

Present State of Nickel Plating. Technique of Deposition and Specifications (Etat Actuel du Nickelage Technique du Depôt et Specifications). MARCEL BALLAY. *Métaux et Machines (Science et Industrie),* Vol. 19, June 1935, pages 201-204. Recent developments have permitted increasing thickness of deposits up to 1 mm. in special cases. Thickness of 0.02-0.03 mm. is quite common. Cr plating has contributed to improvement of Ni plating for Cr is now always laid on an underlying Ni coating. Ni plating is more and more used for repairing worn parts. Modern Ni plating practice is as follows: Parts are treated in petrol, trichloretylene, etc. which have replaced soda or potash solutions. They are then electrolytically degreased, a method which has supplanted that of brushing with lime or pumice. In electrolytic treatment, slightly alkaline salts such as phosphates and silicates are used. Generally, parts are slightly corroded in an adequate bath before plating. Ni plating baths are now relatively simple; they are essentially $NiSO_4$, a chloride to promote corrosion of anodes and a substance to prevent rapid changes in acidity of the bath. pH of the bath is now carefully controlled; too low a pH gives blown coatings, too high a pH means brittle coatings. Hot working baths are now in general use. Baths containing colloidal matter give bright deposits but generally brittle. Cu undercoat, previously considered necessary on ferrous alloys to obtain good protection against corrosion, is now often discarded. For good resistance to corrosion the total thickness (Ni, Cu + Ni or Ni + Cu + Ni) must be at least 0.02 mm. French Railway Companies specify for ordinary Ni plating a minimum thickness of 0.01 mm., for quality steel parts a minimum thickness of 0.02 mm. For Cu alloys thickness varies from 0.005 mm. to 0.02 mm. according to uses. Those specifications have contributed greatly to the progress of Ni plating technique. FR (8d)

Electrodeposition of Nickel from Nickel Chloride Solutions (Elektrolytische Nickelabscheidung aus Nickelchloridlösungen). N. FEDOTIEFF & R. KINKULSKY. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 224, Oct. 18, 1935, pages 337-350. For most efficient deposition of Ni from $NiCl_2$ solution the pH should be 6.8-6.2; with other conditions as follows, temperature between 70°-80° C., 40 g. Ni/l. minimum and c.d. below 4.5 amps./dm.^{2}, a dense deposit of Ni is easily obtained. A c.d. between 4.5-6 amps./dm.^{2} may be used with lower Ni concentration, but current efficiency is thereby decreased. Electrolysis of $NiCl_2$ is stated to have an advantage over $NiSO_4$ in that no contamination from S occurs, lower energy is required because of higher conductivity and lower anode potential. The suggestion is made that a combination of Ni ores and electrolysis will be cheaper process than present ones, and that the noble metals will be won at the same time with the Ni. Curves are given for solubility of $NiCl_2$ versus temperature, conductivity versus $NiCl_2$ concentration at various temperatures, curves showing current efficiency versus pH of electrolyte, current efficiency versus c. d., concentration of $NiCl_2$, and versus temperature, voltage curves versus concentration of $NiCl_2$ versus temperature, and anode potential versus c. d. and concentration, graphite anode potential versus c. d. and concentration included. WB (8d)

Electrodeposition of Tin for Refrigerating Purposes. E. A. JOHNSON. Paper read before the *Electrodepositors' Technical Society,* Apr. 10, 1935, pages 119-124. Describes operation of an 800-gallon alkaline tin bath used in plating refrigerator evaporator coils. Approximate composition of solution ozs. per Imperial gallon: Metallic Sn .35 to .63 (supplied as $SnCl_2$), KOH .6 to 2.8, K_2CO_3 15, plus "glutenoid powder." Good throwing power is claimed (66.6%). A thickness of about .0004" is deposited at a c.d. of 5 amps./ft.^{2} GBH (8d)

8e. Metallic Coatings other than Electroplating

Detection of Flaws in Protective Coatings. G. W. CLARVOE. *Water Works Engineering,* Vol. 88, May 1, 1935, pages 483-484, 487. Flaws in bituminous coatings are attributed to: improper decomposition resulting from mistreatment during preparation for application, ruptures caused by careless handling of the coated pipe, pinholes formed by the formation of bubbles, and uncoated spots. Flaws are detected by an electrical device which is based on the principle that the instantaneous dielectric strength of asphalt or coal tar enamel is greater than that of air. The coating is subjected for a brief interval to a voltage high enough to break down very thin spots in the coating or the air held in pinholes. Among the advantages of this device are accuracy and speed. CBJ (8e)

Why Spray Metal? R. A. AXLINE. *Metallizer,* Vol. 3, June 10, 1935, pages 6-8, 10. Rebirth of metal spraying in U. S. in midst of the depression is emphasized as indicating its value in making better new products and for salvaging worn, corroded or scored equipment. Applications of metal spraying include; use in the trucking industry for repairing and rebuilding worn parts, in the milk industry for prevention of corrosion and contamination of food products, and in power generation plants for corrosion prevention and numberless repair problems. Glass lined tanks are readily repaired by using tin. Many cooling coils and the like are sprayed rather than wiped with tin because of the much thicker coatings obtainable by spraying. Stainless steel is sprayed on dairy equipment where heavy wear is encountered. BWG (8e)

Metallizing in Canada. R. S. TUER. *Iron & Steel of Canada,* Vol. 18, Mar.-Apr. 1935, pages 26-27. Metal spraying as means for preventing corrosion, erosion, to repair worn or defective parts or for decorative work, is briefly discussed. Ha (8e)

Canadian National Railways Calls for a Test. R. J. McWATERS & J. W. HISHON. *Metallizer,* Vol. 3, June 10, 1935, pages 2-3, 12. Tests on spray speed and deposit efficiency at Toronto definitely showed wire to be superior to powder as a medium for spraying metal. Although more Zn powder could be sprayed in a given time than Zn wire, the Zn loss was far greater. From the cost per pound of Zn deposited, the cost of coating railway bridge deck girders with 6 oz./ft.^{2} was calculated to be 13.65c/ft.^{2} for a wire gun compared to 31.8c for a powder gun; for a 2 oz./ft.^{2} coating on webbing, costs would be 4.55c and 10.6c respectively. Disadvantages of the powder gun include pre-oxidation and burning of the metal, greater distance necessary between pistol and work, awkwardness in handling bulky powder and vibration in the powder container. BWG (8e)

Hard Facing with Boron. MILES C. SMITH. *American Machinist,* Vol. 79, July 31, 1935, pages 548-550. Metal objects can be hard-faced by boron in crystal form, which is applied to Fe or low C steel either by "sweating on" or "casting on." In the first, the surface of the metal is brought to a sweating heat whereupon the B crystals (of less than 60 mesh) congeal with the surface to form a smooth, abrasive-resistant, corrosion-resistant, and heat-resistant skin. In "casting on," the object is placed in a mold and the molten B is poured around it so that a shell is formed which is solidly and firmly alloyed with the parent metal and can be ground to give a highly polished surface. The cast-on surface is dense and has a hardness of about 545 Brinell. The procedures for both methods are described in detail with examples to illustrate. Ha (8e)

Schori Metal-spraying Equipment. *Machinery,* London, Vol. 46, Sept. 26, 1935, pages 806-807. A gun for metal spraying is described which uses powdered metal drawn to the acetylene flame by suction. High pressure air serves to ignite the gas and to propel the metal to the work. WB (8e)

8f. Non-Metallic Coatings

The Effect of Temperature Treatment on Glass to Metal Seals. J. T. LITTLETON. *Journal American Ceramic Society,* Vol. 18, Aug. 1935, pages 239-244. Glass-to-metal seals can be produced in strain-free condition by proper heat treatment but determination of stress distribution is necessary before the heat treatment suitable for the particular combination can be prescribed. Photo-elastic method of studying stress distribution under different temperature conditions is illustrated by photos. WB (8f)

Painting Zinc and Zinc Alloy Surfaces. HARLEY A. NELSON. *Industrial & Engineering Chemistry,* Vol. 27, Oct. 1935, pages 1149-1152. Primarily a discussion of the factors thought to influence the initial and the subsequent adherence of paint on Zn and Zn-alloy surfaces. Possible surface relationships existing between the metal and the paint and possible changes in the chemical and physical nature of the paint films upon aging are considered. Discussion of pretreatments of the metal surface and of painting procedure is also included. MEH (8f)

Enameling and De-enameling Feature Finishing of Washing Machine Tubs. F. L. PRENTISS. *Iron Age,* Vol. 135, May 16, 1935, pages 26-29, 74. Methods and equipment of the Youngstown Pressed Steel Co. are described. Production methods have been improved and scrap losses have been reduced by de-enameling parts with defective coatings. NaOH bath being used for the purpose. Furnace used is electrically heated and controlled and tank containing bath is set in heating chamber. Pieces to be de-enameled are immersed in bath for a minimum of 7 min., the time depending on nature of article, gage of steel and number of enamel coatings. NaOH is used up during operation and more NaOH in flake form is added to maintain liquid at proper level 8" or 9" from top of tank. Black sludge which forms settles in tank and is removed. After removal of enamel work is dipped in boiling H_2O and finally pickled. VSP (8f)

Finishing Motion Picture Cameras and Projectors. C. A. ZIEBARTH. *Iron Age,* Vol. 136, Aug. 15, 1935, pages 16-19, 85. Method used by Bell & Howell Co. for coating cameras and projectors is described. It consists of an undercoat of heavy-body rubber-finish enamel and a tung oil base enamel which produces a "damaskene" finish. Color effects are obtained by spraying the damaskene finish with lacquer. Plugs and covers are used to protect areas not to be enameled or lacquered. VSP (8f)

Protective Paints for Structural Steelwork. H. N. BASSETT. *Industrial Chemist,* Vol. 11, Apr. 1935, pages 159-160. General discussion of metal preparation, the priming coat, bituminous and graphite paints and finishing coats. RAW (8f)

Antimony Compounds as Substitute for Tin Oxide in White Coloring of Enamels, and the Hygienic Rating of Antimony-Containing Enamels (Antimonverbindungen als Ersatz von Zinnoxyd zum Weissfärben von Emails, sowie die gesundheitliche Beurteilung von antimonhaltigen Emails). K. BECK. *Korrosion & Metallschutz,* Vol. 11, June 1935, pages 132-133. Experiments in the German State Institute of Hygiene have shown that Na meta-antimonate (Leuconine $NaSbO_3$) and Sb trioxide which are used as pigments in white enamels, become harmful to health only if the pentavalent oxide compounds become converted into the trivalent compounds. Cooking utensils which come into contact with foods must not show, after ½ hr. cooking with 3% tartaric acid, more than 3 mg. trivalent Sb for each l. content of the vessel. This requirement can easily be met by suitable enameling procedure. Ha (8f)

How Good Is the Finish on Your Refrigerator. P. W. PROUTZ. *Electrical Manufacturing,* Vol. 16, July 1935, pages 20-23. In discussion of Fe base for enamelling, micros shown of cold-rolled, stretcher-levelled "furniture steel" with various good and bad surfaces. Hardness tests for the enamel consisting in pressing an alloy cutting tool against the finish, the pressure required to "kill" the surface, being taken as a measure of the hardness. Other tests include; (a) impact test with a 1" diam. steel ball (65 grams) falling 30" and delivering a glancing blow 45° to the surface, (b) flexibility test in which the finished sheet is bent to induce cracking of the enamel. Color fastness is tested by 1,000 hour exposure to ultra violet radiation. Ductility tests with Erichsen machine differentiates between brittle and elastic enamel finish. The embrittling effect of grease, meat and vegetables is tested under humid conditions to failure of the finish by checking, crazing and rusting. WB (8f)

Aircraft Coatings. E. W. J. MARDLES. *Paint, Colour, Oil, Varnish, Ink, Lacquer Manufacture,* Vol. 5, Jan. 1935, pages 8-13; Feb. 1935, pages 46-49. The conditions which protective coatings in aircraft must withstand are discussed. The discrepancy between laboratory and service results is emphasized. Great stress is laid on the difficulties arising from lack of adhesion. Scratch hardness and bending tests are utilized in testing coatings. For any particular paint film, the scratch hardness is usually least on glass, low on Cd-plated steels and anodized Al and highest on sand-blasted steel or Al. Weathering tests showed that after 3 weeks, films could be scraped off plated steels, Cu and tinned Fe with the thumb-nail, whereas the adhesion on steel and Al showed a smaller drop. After immersion in sea-water, the adhesion of films on plated steel, anodized Al and stainless steel again showed a greater drop than on plain steel or Al. The more carefully prepared Cd-plated steels resisted salt-water spray tests much better. Linseed oil varnishes and paints afforded the best adhesion and protection to Cd- and Zn-plated steels, especially when finished with a cellulose or synthetic resin enamel. Unlike cellulose undercoats, oil paint undercoats (ordinary linseed oil paints secured proper adhesion of the cellulose finish to anodized Al and other metal surfaces. Synthetic resin enamels rapidly lost adhesion on steel when immersed in sea-water. Extensive tests proved the marked superiority of oil varnish paints as undercoat and synthetic resin paints or enamels as finishing coat especially for seaplane work. Hard, tough films (for instance cellulose lacquers) were found to be less resistant to sand erosion than softer and more resilient films. Wool, wax, lard oil, petrol jelly, linseed oil are used for preserving anodized Al and other metal surfaces during storage or transit. The presence of minute amounts of hydrobromic acid in the engine cylinder resulting from the use of "leaded" fuels promotes corrosion. Mixtures of castor oil or lard oil with triethanolamine are recommended for engine interiors. Results of weathering and immersion tests correlating scratch hardness, kind of metallic carrier and paint coatings utilized are presented in 10 diagrams. EF (8f)

Historical Investigation of the Phosphate Protection of Iron, Cast Iron and Steel (Ricerche sulla Storia della Protezione fosfatica del Ferro, Ghisa, Acciaio). O. MACCHIA. *Industria Meccanica,* Vol. 17, July 1935, pages 617-618. The historical development of phosphatization (parkerizing, bonderizing) of Fe as rust protective means is outlined. 18 references. Ha (8f)

Characteristics of Anodized Aluminium. R. E. PETTIT. *Product Engineering,* Vol. 6, Aug. 1935, pages 292-294. The "Alumilite" process produces on Al an oxide coating of about 0.001" thickness by anodic treatment in a H_2SO_4 bath at room temperature; this coating has greater hardness and wear resistance and higher dielectric strength than the natural oxide film. In addition, the coating is absorptive and can be colored with dyes or mineral pigments. Examples of application in machinery and for decorative purposes are cited. Ha (8f)

The First Coat is the Most Important. Notes on Mill Scale and Aluminum Graphite Paints. C. R. AVERILL. *Gas Industry,* Vol. 12, Mar. 1935, pages 152-154. Emphasizes the superior properties of a red-lead graphite primer. For the first coat, boiled linseed oil is used mainly as a vehicle. On exposed surfaces, especially those exposed to sea-air or damp and acid laden atmospheres, the final coat can be very much strengthened and rendered more impervious by the use of boiled oils containing a percentage of tung or wood oil. Al graphite paints can be successfully applied to crowns of gas holders. They stand well under internal heat. They are not quite so bright as straight Al paint and are very satisfactory as a ground or second coat. WH (8f)

Paint and Painting for Gasworks. M. ARCHER. *Gas Industry,* Vol. 12, Mar. 1935, pages 147-150. Paints in gasworks are used to preserve and to decorate. The "old and tried friend" red lead oxide is permanent in color, hard wearing, immune against fumes, reasonable in cost, easy to apply, of good covering power but its decorative effects are limited. The treatment of structural steel work prior to painting is exhaustively discussed. The deterioration of coatings due to galvanic action is considered. Claims that there is no one-coat paint which is effective for any length of time. For finishing paints in gasworks, white Pb compounds are taboo, Cr compounds in connection with greens are to be recommended, and Fe oxide pigment in correctly chosen polymerized oil is well known for resistance. Al paints give excellent results except in alkaline atmospheres. Ordinary raw and boiled linseed oils do not possess sufficient properties to ensure the correct weather-proof, water-resisting film. WH (8f)

9. TESTING

9a. Inspection & Defects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

Efficient Inspection Calls for Proper Equipment. F. B. JACOBS. *Canadian Machinery,* Vol. 46, Oct. 1935, pages 17-18. Inspection at Cleveland Tractor Co. plant, Cleveland, Ohio described and shown in photos. WB (9a)

Rail Fissures Traced to Shattered Steel and Heavy Wheel Loads. H. F. MOORE. *Engineering News-Record,* Vol. 115, Sept. 19, 1935, pages 395-400; *Railway Age,* Vol. 99, Sept. 1935, pages 269-273. Dangerous transverse-fissure type of failure is closely related to shatter-cracking which may be controlled by careful thermal treatments after rolling. CBJ (9a)

The Inspection of Die Castings Improved Control Methods. R. W. P. LEONHARDT. *Metal Industry,* London, Vol. 46, June 7, 1935, pages 617-619. The manufacture of perfect die castings requires in addition to knowledge of the mechanical part of the process, experience relative to the composition and treatment of the materials used, making necessary metallurgical inspection from raw material to finished product. Rigid specifications, eliminating all but the highest grade of purity of raw materials, are essential. In addition to the recognized chemical methods, spectrum analysis can be used to advantage and an application of this method is described. It is recommended that in addition to the usual testing methods used to insure clean sound metal that pyrometric control of melting processes, density tests and X-ray analyses be utilized. Micrographic examination and testing for corrosion resistance are suggested. HBG (9a)

9b. Physical & Mechanical Testing

W. A. TUCKER, SECTION EDITOR

Impact and Static Tensile Properties of Bolts. H. L. WHITTEMORE, G. W. NUSBAUM & E. O. SEAQUIST. *Mechanical World & Engineering Record,* Vol. 48, July 12, 1935, pages 27-30. Tests at the Bureau of Standards on 360 specimens representing all possible combinations of 5 different materials, 4 different bolt diameters and 3 different forms of screw-threads. See *Metals & Alloys,* Vol. 6, July 1935, page MA 290R/2. WH (9b)

The Determination of Moisture in Molding Sands. S. E. DAWSON & F. T. HANKS. *Foundry Trade Journal,* Vol. 53, Aug. 15, 1935, pages 113-114. Moisture determination apparatus for molding sand consists essentially of a special form of electrodes, used in conjunction with an ohm-meter and suitable battery, the electrodes being so designed as to get most contact with the mass to be tested. The electrodes are provided with 4 stems and spikes, the stems being of convenient length to cause the conically formed spikes or contacts to penetrate the mass under test to any desired depth. The electrodes are cross connected, thus causing the whole circuit to be balanced. The conductivity of a mass of sand increases with increased temperature and density. The percentage of moisture is read directly from the ohm-meter. AIK (9b)

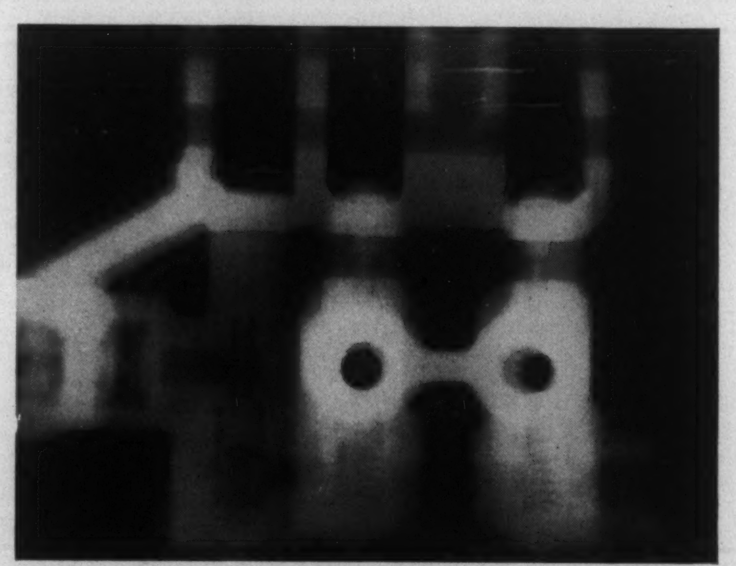
A. S. T. M. Committees Report Corrosion and Metallographic Data. *Iron Age,* Vol. 136, July 18, 1935, pages 22-28, 39-40. Abstract of reports of committees on metallographic testing and on corrosion presented at the Detroit meeting of the American Society for Testing Materials. VSP (9b)

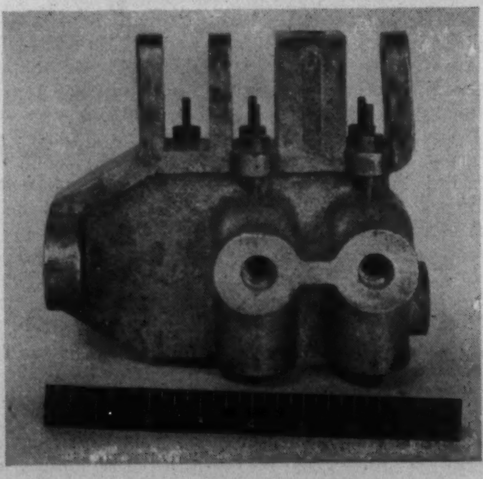
9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Some Aspects of the Fatigue Properties of Patented Steel Wires. II.—Note on the Effect of Low-temperature Heat Treatment. E. T. GILL & R. GOODACRE. *Iron & Steel Institute,* Advance Copy No. 4, Sept. 1935, 23 pages. The effect of low-temperature tempering on the fatigue properties of 4 series of C steel wires was studied. The series contained 0.37, 0.55, 0.79, and 0.86% C steels and samples of each series had reductions varying from 25 to 90%. The wires were free from decarburization but not polished. Generally, there was an increase in fatigue strength on tempering, the greatest fatigue strength resulting from tempering at 200° C. With all of the steels examined there was a critical reduction, at which point under certain tempering conditions the fatigue strength fell considerably below that for the as-drawn material. This critical reduction decreased as the C content increased. Fatigue strengths as high as 44.9 tons/in.^{2} were observed and it is suggested that if the materials had been polished a fatigue strength of the order of 55 tons/in.^{2} would have resulted. As far as could be observed there was no relationship between other mechanical properties and the fatigue strength. JLG (9c)





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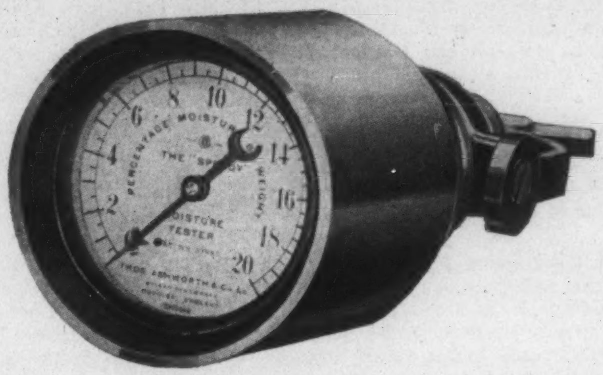

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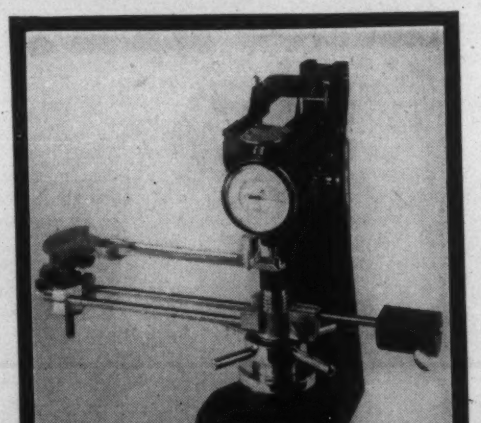

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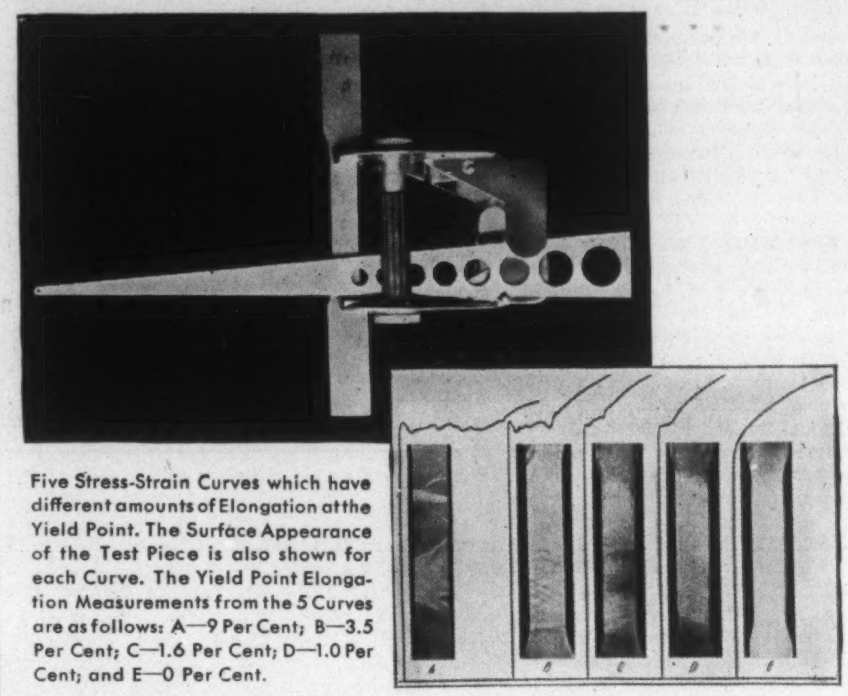

Five Stress-Strain Curves which have different amounts of Elongation at the Yield Point. The Surface Appearance of the Test Piece is also shown for each Curve. The Yield Point Elongation Measurements from the 5 Curves are as follows: A—9 Per Cent; B—3.5 Per Cent; C—1.6 Per Cent; D—1.0 Per Cent; and E—0 Per Cent.

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In this analysis, Mr. Kenyon has defined many properties of materials, such as upper yield point, lower yield point, yield point elongation, uniform elongation and other values of the plastic range. He has also shown the relation of yield point elongation and the severity of stretcher strain. (See illustration above.)

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PRESSURE BLOCKS VIBROGRAPHS TORSIOGRAPHS

Investigation of the Fatigue Strength of Cold Drawn Copper and Pure Aluminum Wire (Untersuchungen über die Schwingungsfestigkeit von kalt gezogenen Drähten aus Kupfer und Reinaluminium). W. Schwinning & E. Dorgerloh. *Zeitschrift für Metallkunde,* Vol. 27, 1935, pages 33-37. In a study of the mechanical and electrical properties of Cu and Al wire (purity not stated), as a function of the degree of reduction in drawing, a measurement of the tensile strength, elastic limit, elongation, reduction in area and electrical conductivity and a new determination of the fatigue properties have been made. The findings in the group of repeated measurements are in substantial agreement with other published data on the subject. The endurance limit is shown to increase as a linear function of the degree of reduction in drawing except that there are inflections in the curves for Cu at 41, 82, 93, and 98% reduction and for Al at 62, 88, 96, and 98% reduction. The direction of the inflections is such as to indicate a less rapid increase in the endurance limit of Cu and a more rapid increase in the endurance limit of Al with greater degrees of reduction in drawing. The Wöhler fatigue values for both metals are shown to increase with added reduction, slowly up to 80% and then more rapidly. The electrical conductivity of Al is not appreciably affected by the degree of reduction, but that of Cu decreases up to a reduction of 80% after which it increases again up to 94% reduction. It is recommended that hard drawn Cu wire for electrical purposes be heated for 2 hours at 100° C. to remove the internal stresses. FNR (9c)

Avoid Waste of Material in Parts Design. V. L. Maleev. *Machine Design,* Vol. 7, Aug. 1935, pages 23-25, 40. Continuing a 4-part series, the paper discusses failure from repeated loads due to a crack occurring at the point of highest stress, interrelation between ultimate strength and endurance limit in bending (steels = $\frac{1}{3}$ and non-ferrous metals = $\frac{1}{4}$) [Note by H. F. M.: The value for steel is usually reported as larger than $\frac{1}{3}$ and for non-ferrous metals it varies from $\frac{1}{2}$ to $\frac{1}{5}$], construction of interpolated diagrams, development of endurance stresses, effect of notches on surfaces. One of the accompanying diagrams shows values of surface coefficients to be used for bending, tension and compression in relation to ultimate static tensile strength and to polishing, grinding, rough finishing and to samples provided with a sharp circular groove, a skin from hot rolling under corrosive conditions (city vs. salt water). WH (9c)

Tensile Strength of Bars Jointed by a Combination of Riveting and Welding (Trekvastheid van staafverbindingen bestande uit combinatie's van klink- en laschnaden). *Polytechnisch Weekblad,* Vol. 29, July 4, 1935, pages 426-427. Static and dynamic testing results by Kommerell & Bierett on riveted test pieces reinforced in various ways by welding and submitted to tensile and dynamic stresses are summarized. The strengthening by welding proved to be very effective under static loads but not so effective under dynamic loads. WH (9c)

Fatigue Strength of Butt Welds. B. P. Haigh. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 795-802. Gives data on fatigue strength of butt-welded joints. Concludes that the range of stress from 0 to $9\frac{1}{2}$ or 10 tons/in.^{2} is required to break butt welds in mild steel plates even when gas holes and slag particles are present in large numbers. See also *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 458R/2. JLG (9c)

Discussion of "The Relation of Fatigue to Modern Engine Design." *Transactions North-east Coast Institution of Engineers & Shipbuilders,* Vol. 51, 1934-35, pages D99-D136. For abstract of original paper see *Metals & Alloys,* Vol. 6, May 1935, page MA 200. WB (9c)

The Correlation of Spring-Wire Bending and Torsion Fatigue Tests. E. E. Weibel. *Transactions American Society of Mechanical Engineers,* Vol. 57, Nov. 1935, pages 501-516. Methods for gripping were developed particularly for bending and torsion fatigue tests. Zero-to-maximum torsion fatigue values for straight specimens in the as received condition were about 70% higher than values estimated from previous tests on carefully coiled springs. Removal of the natural surface by grinding increased the bending fatigue strength about 20% but decreased torsion fatigue strength about 4%. Shot-blasting increased the bending fatigue strength about 27% and increased the torsion fatigue strength an undetermined amount. The zero-to-maximum torsion fatigue limits of 2 wire specimens in the as received condition were 1.5-1.6 times their resp. bending fatigue limits, while the ratios of reversed torsion fatigue to reversed bending fatigue strength were 0.84 and 0.90. Test curves and structural photographs are given. (Note by HFM: The ratios quoted for results of bending and torsion fatigue test results indicate that under torsion the specimens failed by diagonal tensile strain rather than by shear. This is in harmony with the appearance of torsion fatigue fractures, which follow the inclined path of a tension failure rather than the transverse or longitudinal path of a shear failure. The ratio of reversed torsion fatigue limit to reversed bending fatigue limit of 0.84 to 0.90 would indicate a failure due to cycles of reversed maximum tensile and compressive strain). 35 references. Ha (9c)

■ 9e. Spectrography ■

Errors in the Quantitative Spectrum Analysis of the Fe-Si System (Ueber den Fehler bei der quantitiven Spektralanalyse des Systems Eisen-Silizium). G. Scheibe & A. Schöntag. *Archiv für das Eisenhüttenwesen,* Vol. 8, June 1935, pages 533-540. In determining the Si content by comparing the intensity of the lines Si 2516 : Fe 2518 A.U., errors may occur as follows:—variations in sensitivity of photographic plate a maximum of ± 8%; the thermoelectric potentiometer ± 1.5%; variations in the length of spark and electrical excitation ± 2%. In steel the average error would be about ± 3% and in the most unfavorable case ± 8%; in white cast iron a maximum error of 9% may occur—in gray cast iron ± 11%. SE (9e)

The Temperature Scales of Columbium, Thorium, Rhodium, and Molybdenum at 0.667μ. L. V. Whitney. *Physical Review,* Vol. 48, Sept. 1935, pages 458-461. To establish temperature scales for Cb, Th, Rh, and Mo spectral emissivities were measured for these metals at $\lambda = 0.667\mu$, in the temperature range of 1300° to 2200° K. Rolled cylinders were more satisfactory for measuring emissivities than specimens in other forms. Rigorous heat treatment was found necessary for accurate results. WAT (9e)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Preparation of Fine Wires by Freezing Liquid Metal Jets (Die Herstellung dünner Drähte durch Erstarren flüssiger Metallstrahlen). G. Tammann & G. Moritz. *Zeitschrift für Metallkunde,* Vol. 27, May 1935, pages 114-115. By forcing low-melting metals through conical nozzles 0.04 to 0.1 mm. in diameter, liquid jets 20 to 100 cm. long respectively were formed. These solidified into wires which showed a variation in diameter of about 3%. Pressures of 3 to 5 atm. were used. With lower pressures, or liquids more than 40° above the melting point, the jets tended to break into droplets due to the action of surface tension. Smooth wires were obtained from Sn, Bi, Zn, Pb, Al, and the binary eutectics of Bi, Cd, Pb, and Zn. Rough surfaces resulted from Cd and Sb. Good jets could not be obtained with Ag or Cu with pressures up to 13 atm. Wires of the pure metals contained single crystals up to 1 cm. long. GD (10)

A Metallurgical Puzzle. J. S. Glen Primrose. *Edgar Allen News,* Vol. 14, Nov. 1935, page 749. The question was discussed whether it would be possible to produce a steel specimen which on polishing and suitably etching would show all common constituents. By quenching a plain C steel containing between 0.8 and 1.1% C while it was passing through the $Ac_{3,2,1}$ transformation, a combination of pearlite, sorbite, troostite and martensite could be produced in the same specimen if the steel was previously in the pearlitic condition. Ha (10)

Structures of Intermetallic Compounds of Beryllium with Copper, Nickel and Iron (Strukturen intermetallischer Verbindungen des Berylliums mit Kupfer, Nickel und Eisen). Lore Misch. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29, June 1935, pages 42-58. The crystal structure of compounds of the systems: Cu-Be, Ni-Be, and Fe-Be has been determined by X-ray spectrographic analysis. CuBe is body-centered cubic of the Cs-chloride type with 2 atoms in the unit cell, a = 2.698 ± 0.007 A.U. at about 12.52% Be, in agreement with determinations of Masing, Holm & Dahl (*Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern,* Vol. 8, 1929-1930, pages 154-186). $CuBe_2$ is face-centered cubic of the $MgCu_2$ type with 24 atoms in the unit cell, a = 5.940 ± 0.03 A.U. at 26.7% Be. $CuBe_2$ is stable only in presence of an excess of Be, in agreement with findings of Oesterheld (*Zeitschrift für anorganische und allgemeine Chemie,* Vol. 97, 1916, pages 1-40) and of Borchers (*Dissertation, Technische Hochschule Aachen* 1930). NiBe is body-centered cubic of the Cs-chloride type with 2 atoms in the unit cell, a = 2.603 ± 0.003 A.U. at 14.5% Be. Ni_5Be_{21} is, probably, of the γ-brass type, which, however, appears to be slightly deformed. Its lattice constant is, on an average, a = 7.56 A.U., allowing variations of the indices by 2%. $FeBe_2$ is hexagonal of the $MgZn_2$ type with 12 atoms in the unit cell, a = 4.212 ± 0.005 A.U., c = 6.834 ± 0.005 A.U., a/c = 1.623. It belongs to space group D^4_{6h}. $FeBe_5$ is face-centered cubic of the $MgCu_2$ type with 24 atoms in the unit cell, a = 5.878 ± 0.006 A.U. The distribution of Fe and Be atoms on lattice positions is identical with that of Cu and Be atoms in $CuBe_2$. $FeBe_2$ is ferromagnetic, its Curie point is within the temperature interval from 521° to 524° C. $FeBe_5$ is non-magnetic at normal temperature, but is attracted by a magnet at the temperature of liquid air. A new phase has been observed, both microscopically and X-ray analytically, in the system Fe-Be. Its crystal structure as well as those of intermediary compounds of the system Co-Be will be reported later. ORS (10)

Transformation, Hardness, and Tempering Changes in Steels with up to 1% C and up to 12% Cr (Umwandlungs-, Härtungs-und Anlassvorgänge in Stählen mit Gehalten bis 1% C und bis 12% Cr). W. Tofaute, A. Sponheuer & H. Bennek. *Archiv für das Eisenhüttenwesen,* Vol. 8, May 1935, pages 499-506. Based on results of heat treatments sections of the Fe-Cr-C diagram are shown for 0.1, 0.4, 0.7, 1.0, and 1.5% C and 1.5, 3, 5, 8, and 12% Cr. The critical cooling velocity is appreciably lowered by Cr. In the hypereutectoid steels containing the complex carbide $(Cr, Fe)_7\ C_3$, the quenching temperature must be just under the solution temperature of this carbide to attain maximum hardness. Depth of hardening increases with increasing Cr content so that sections 60 mm. in diameter can only be deep hardened when the complex carbide $(Cr, Fe)_7\ C_3$ is present. Nevertheless the quenching temperature must be below the solution temperature of the complex carbide to get maximum hardness. Steels containing this carbide retain their hardness well on tempering, apparently because of precipitation hardening. This effect increases with increase in the hardening temperature, probably because of solution of the carbide. With high Cr contents of 5% and more, large amounts of retained austenite are formed on quenching; this breaks down on tempering and thus also raises the hardness on tempering the first time. A certain degree of retention of hardness on tempering is conferred by Cr, however, even in the absence of the complex carbide. SE (10)

Transformation Temperatures of Martensite and Austenite in Hardened Steels (Martensitens och restaustenitens omvandlings-temperaturer). Bengt Kjerrman. *Jernkontorets Annaler,* Vol. 118, June 1935, pages 217-231. Transformation temperatures were determined by the change in electric conductivity of a steel having the composition 1% C, 1% Mn, 0.5% Si, 1% Cr. With a moderate temperature rise, martensite decomposed at 110°-150° C. and austenite at 240°-290° C. With very slow heating, however, martensite was found to decompose at 40° C., and the authors think even at room temperature. The results of experiments when 150° C. was applied for 1 hour and 120° C. for 280 days indicate that austenite does not begin to decompose until nearly all the tetragonal martensite has disappeared, but when this has occurred, austenite decomposes slowly at 120° C. HCD (10)

Solubility of Copper in Magnesium in the Solid State (Solubilité du cuivre dans le magnésium à l'état solide). N. I. Stepanov & I. I. Kornilov. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 89-98. The electric conductivity, temperature coeff. of electrical resistance and hardness of the alloys of Mg with Cu up to 4% by weight of copper were investigated in the cast and annealed state (annealing at 300°, 400°, and 480° 12-14 days and cooling in cold water). The solid solubility of copper in magnesium was determined as 0.2% at 300°, 0.3% at 400° and 0.55% at 480° C. NA (10)

Physico-chemical Study of the γ-phase in the System Thallium-Bismuth (Investigation physico-chimique de la phase gamma des alliages du thallium avec le bismuth). N. S. Kurnakow, V. A. Ageewa & N. W. Ageew. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 49-58. The γ-phase has a flat maximum on the liquidus at 62.8% at. % Bi, the homogeneous range being 55 to 65 at. % Bi. The electric-conductivity curve in this range does not show a singular point. The X-ray indicates that γ-phase has a lattice very close to the Bi lattice. The γ-phase can be considered a compound of variable composition. NA (10)

Isotopic Constitution of Palladium and Gold. A. J. Dempster. *Nature,* Vol. 136, July 13, 1935, page 65. Ions from a high frequency spark in a mass spectrograph revealed isotopes with the following atomic masses for Pd: 102, 104, 105, 106, 108, 110; no isotopes could be detected for Au so it is concluded that the accepted atomic weight, 197.2, is too high. CSB (10)

Alloys of Palladium with Manganese (Les alliages du palladium avec le manganèse). A. T. Grigoriew. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 75-88. The alloys of Pd with Mn form the unbroken range of solid solutions. The liquidus curve has the minimum at 25-30 at. % Pd. In the solid state the compound PdMn forms which was studied by thermal analysis and hardness measurement. The thermal points in the Mn-rich alloys at 1040°-1089° and 790°-797° can be taken as the Mn transformations $\gamma \longrightarrow \beta$ and $\beta \longrightarrow \alpha$. NA (10)

Physico-chemical Study of the Alloys of Thallium with Bismuth and Lead (Investigation physico-chimique des alliages de thallium avec le bismuth et le plomb). N. S. Kurnakow & V. A. Ageewa. *Izvestia Instituta Fiziko-Khimicheskogo Analiza,* Vol. 7, 1935, pages 99-122. The ternary system Th-Bi-Pb was investigated by the following methods: thermal analysis, electric conductivity and microstructure. The liquidus surface was constructed for this system. The broad range of the homogeneous γ-phase of the system Th-Bi in the ternary diagram was developed. The ternary solid solution of γ-phase has the properties of a compound of variable composition. NA (10)

The Optical Constants of the Copper-nickel Alloys. H. Lowery & H. Wilkinson. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Aug. 1935, pages 390-410. With the view of finding a correlation between optical constants of binary materials and their constitution, the refractive index, absorption coefficient, and reflection coefficient were determined on Cu-Ni alloys. The curves obtained show a continuous, but non-linear variation with the mixture for all constants throughout the series with maxima depending on the wave length of the light used. Full data on measuring method and tables giving complete results are added. 28 references. Ha (10)

Crystal Structure of $MgNi_2$ and Its Relation to the Types $MgCu_2$ and $MgZn_2$ (Die Kristallstruktur des $MgNi_2$ und seine Beziehungen zu den Typen des $MgCu_2$ und $MgZn_2$). F. Laves & H. Witte. *Metallwirtschaft,* Vol. 14, Aug. 16, 1935, pages 645-649. The structure of $MgNi_2$ was determined by X-ray investigation and found to be equivalent to a mixture of the $MgCu_2$ and $MgZn_2$ types. It is hexagonal with a = 4.805 A.U. and c = 15.77 A.U. The number of molecules in a cell is 8. Typical of these 3 phases is the spatial penetration of the Mg and the other metal atoms. 6 references. CEM (10)

Twinning in Alpha Iron. Hugh O'Neill. *Nature,* Vol. 135, June 29, 1935, pages 1076-1077. Perhaps twinning occurs in γ iron as well as in α, and, if so, the resultant orientations might be different in the 2 cases. Suggests that twinning behavior might in some way be responsible for better ductility and better Erichsen values in mild steel tinplate when cold-rolled and annealed than when hot-rolled and normalized. CSB (10)

Explanation of the Hume-Rothery Rule for Intermetallic Compounds (Zur Deutung der Hume-Rotheryschen Regel für Intermetallischen Verbindungen). U. Dehlinger. *Zeitschrift für Physik,* Vol. 94, Mar. 19, 1935, pages 231-241. Author discusses the formation of the ϵ-phase ($CuZn_3$) in brass on the basis of the outermost electrons and energy relationships. FHC (10)

The Structure of Crystals. Supplement for 1930-34 to the Second Edition. Ralph W. G. Wyckoff. Reinhold Publishing Corporation, New York, 1935. Paper, 5¾ x 9 inches, 163 pages. Price $6.00.

This book is a summary of X-ray crystal structure determinations published during the past four years. Each chapter is an extension of corresponding chapters of Part II of the second edition of "The Structure of Crystals," with the numbering of chapters, figures and paragraphs consistent with the previous book. (See *Metals & Alloys,* Vol. 3, Aug. 1932, page MA 241).

There are more researches on alloy systems reported for this period than for all the previous years covered by the second edition. These are covered by giving the literature references under an alphabetical listing of the alloy systems and giving the structures of intermetallic compounds, but information on solid solutions, superlattices, and constitution diagrams is not included. New determinations are reported for about 50 elements, 125 alloy systems, 90 compounds of the type RX, 90 of the type RX_2, 100 of the type R_mX_n, etc.,—in fact the volume of literature on crystal structure determinations of these compounds and also of hydrates, ammoniates, silicates and organic compounds has been approximately doubled in the last four years. In such an active field periodic supplements to this excellent summary are heartily welcomed. C. S. Barrett (10)-B-

X-Ray Studies of α-iron Magnet Alloys (Röntgenuntersuchungen an α-Eisenmagnetlegierungen). R. Glocker, H. Pfister & P. Wiest. *Archiv für das Eisenhüttenwesen,* Vol. 8, June 1935, pages 561-563. The changes in X-ray spectrographs after various heat treatments of α-Fe permanent magnet steels containing 12% Al and 30% Ni, or 10% Al; 22.5% Ni; 13% Co were compared with the changes in coercive force. At the maximum coercive force no broadening of the lines or change in the lattice constant occurred. Only after long annealing at rather high temperature, during which the coercive force became very small, was a change in lattice constant noted. At still higher temperatures the lines of the lattice of the precipitated γ-phase appeared. Thus, as in duralumin, no percipitation of a separate phase occurs at the point of maximum coercive force and there can be no question of the size of precipitated particle most favorable for permanent magnetism. SE (10)

Crystal Structure of Magnetic Ferrioxide γFe_2O_3 (Die Kristallstruktur des magnetischen Ferrioxids, γ-Fe_2O_3). Gunnar Hägg. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29, June 1935, pages 95-103. X-ray spectrographic analysis established that upon oxidation of Fe_3O_4 at low temperatures the spinel-type crystal structure is preserved up to the composition Fe_2O_3, the lattice constant decreasing continuously from 8.380 A.U. at Fe_3O_4 to 8.322 A.U. at γFe_2O_3. Intensities of interference lines and the densities of the specimens indicate that the increase of the O content during this oxidation is due to the increase of the number of unoccupied positions ("Leerstelle") in the lattice of Fe atoms of the spinel phase. The Fe-rich spinel phase has, most likely, a composition corresponding exactly to Fe_3O_4. In γFe_2O_3 the O content is a maximum, 1/9 of all original positions of Fe atoms remain unoccupied, so that the unit cell contains, on an average, 21⅓ Fe atoms and 32 O atoms. ORS (10)

Crystal Structures of Mg-Al Spinels with an Excess of Al_2O_3, and of γAl_2O_3 (Die Kristallstrukturen von Mg-Al-Spinellen mit Al_2O_3-Überschuss und von γ-Al_2O_3). G. Hägg & G. Söderholm. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29, June 1935, pages 88-94. X-ray spectrographic analysis established that the lattice constant of the $MgO.Al_2O_3$ solid solution (spinel type) decreases continuously from 8.056 A.U. at the MgO-rich end to 7.968 A.U. at the stable Al_2O_3-rich end which is about 67 mol% Al_2O_3. γAl_2O_3 also crystallizes in the spinel type, its lattice constant being 7.843 A.U., and is to be considered as the unstable Al_2O_3-rich end of the $MgO.Al_2O_3$ solid solution. The densities of the specimens indicate that the increase of the O content is due to the increase of the number of unoccupied positions ("Leerstelle") in the lattice of metal atoms of the spinel phase. Concurrently the ratio: Al atoms/Mg atoms increases. In γAl_2O_3 1/9 of all original positions of metal atoms remain unoccupied so that the unit cell contains, on an average, 21⅓ Al atoms and 32 O atoms. ORS (10)

Electron-optical Observation of the Transformation of Iron from the α- into the γ- State (Die elektronenoptische Beobachtung der Eisenumwandlung vom α- in den γ- Zustand). E. Brüche & W. Knecht. *Zeitschrift für technische Physik,* Vol. 16, Apr. 1935, pages 95-98. Allotropic recrystallization of purest electrolytic Fe was studied with an electron microscope—photographically, as described in *Zeitschrift für technische Physik,* Vol. 15, 1934, pages 461-463, and by subjective observation of a suitably coated Fe cathode. It is instantaneous and complete at 907 ± 1.2° C. on heating, and at 898 ± 1.2° C. on cooling. It is irreversible in that the original microstructure is not restored upon reheating to the original temperature after having passed through a cycle of recrystallization. In an Fe-Si alloy with 1% Si the allotropic recrystallization takes place at temperatures about 20° C. higher than in Fe. Polymorphous transformation and allotropic recrystallization occur simultaneously, and the electron-microscopic method is likely to prove suitable for determination of the temperature of polymorphous transformation from observations on allotropic recrystallization. ORS (10)

Atomic Arrangement in Metals and Alloys. W. L. Bragg. *Journal Institute of Metals,* Vol. 56, 1935, pages 275-299; *Foundry Trade Journal,* Vol. 52, May 23, 1935, page 35; *Engineer,* Vol. 159, May 10, 1935, pages 495-496; *Engineering,* Vol. 139, May 17, 1935, page 522; *Electrical Review,* Vol. 116, May 10, 1935, page 670; *Iron & Coal Trades Review,* Vol. 130, May 10, 1935, page 809; *Journal Society of Chemical Industry,* Vol. 54, June 7, 1935, page 557. 25th May lecture to the Institute of Metals, delivered May 8, 1935. An account of the theory of atomic arrangement in alloys is given. The arrangement has 2 features, which may to a large extent be considered independently. The first is the pattern of sites characteristic of each phase, and the second is the mode of distribution of the constituent atoms among the phase sites. In both respects, considerable progress has been made towards an explanation of the features revealed by X-ray analysis. 16 references.
Ha + MS + LFM + AIK + AAA + JLG (10)

Diffusion Experiment as Means for Simple Micrographic Detection of Formation of a Compound between Alloying Components in Ternary and Multiple Systems (Diffusionsversuch als Mittel zum einfachen mikrographischen Nachweis der Verbindungsbildung zwischen Legierungskomponenten in Drei- und Mehrstoffsystemen). M. Bosshard. *Aluminium,* Vol. 17, Sept. 1935, pages 477-481. The detection of compounds of constituents of ternary and higher systems is usually possible by thermal analysis and micrographic examination. A new simple method to detect such compounds consists in placing a plug of a known binary alloy in a slightly conical bore of the specimen. After some time diffusion through the tight contact takes place, and the micrographic examination reveals clearly whether and what compounds have been formed. Ha (10)

Influence of Alloying Elements on Transformation of Austenite and Tensile Properties of Alloy Steels after Interrupted Quenching (Der Einfluss der Legierungselemente auf die Umwandlungen des Austenits und die Festigkeitseigenschaften legierter Stähle bei gestufter Vergütung). H. Döpfer & H. J. Wiester. *Archiv für das Eisenhüttenwesen,* Vol. 8, May 1935, pages 541-548; *Technische Mitteilungen Krupp,* Vol. 3, June 1935, pages 87-99. Steel samples with 0.4 to 1% C alloyed with appreciable amounts of Cr, Si, Mo, W, V, Mn, and Ni, were heated to above the critical temperature, quenched into heated salt baths, and then held at constant subcritical temperatures while the rate of transformation of the undercooled austenite was determined magnetometrically. The rate of transformation was high at just above the martensite transformation temperature and reached a maximum at about 300°-400° C. In Cr, Mo, and V steels the rate of transformation decreased in the region of 500° C. at which austenite was fairly stable; in Ni, Mn, Si, and W steels this intermediate region changed directly over into the pearlite region. The degree of comparative stability at 500° C. is affected by the C and alloy content. Equal hardness can be obtained in this sort of quenching as in ordinary quenching and tempering, and with less chance of cracking because of the avoidance of large internal stresses. SE + MG (10)

Change in Properties of Irreversible Ternary Iron Alloys Through Heat Treatment (Eigenschaftsänderungen irreversibler ternärer Eisenlegierungen durch Wärmebehandlung). W. Köster. *Archiv für das Eisenhüttenwesen,* Vol. 8, May 1935, pages 491-498. On reheating quenched Fe-Co-Mn, Fe-Co-Cr, and Fe-Mn-Cr alloys, tempering effects which would ordinarily occur are inhibited in alloys with low hysteresis and small α-γ transformations, because of the transformation. In alloys with high hysteresis and large α-γ transformation range, annealing results in large property changes, because γ-iron is retained on quenching and is fairly stable, as indicated by the lowering of magnetic saturation and rise in specific gravity. During the tempering a large increase in coercive force takes place. SE (10)

11. PROPERTIES OF METALS AND ALLOYS

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

"K" Monel Metal. *Mechanical World & Engineering Record,* Vol. 47, June 28, 1935, page 632. By addition of Al a new variety of Monel metal has been produced which retains the corrosion resistance of the ordinary alloy but by heat treatment offers additional mechanical properties, data on which are tabulated. Instructions regarding the proper thermal treatment (age-hardening) are also furnished. WH (11a)

What Must the Engineer Know About Brass (Was muss der Ingenieur vom Messing wissen?) Edited by the Kupfer-Institut. VDI Verlag, Berlin, 1935. Paper, 5¾ x 8¼ inches, 134 pages. Price 2.50 RM.

Since the appearance of book on "Copper" edited by the Deutsche Gesellschaft für Metallkunde there has been need for a book on brass and this book is intended to fill this need. It is a worthy successor to its forerunner on copper.

Part I, after a short review of the manufacture of brass, deals with general properties of the copper-zinc alloys, color, influence of the addition of a third element, mechanical and physical properties including thermal and electric conductivity, influence of temperature changes, fatigue strength, corrosion, heat treatment, soldering and welding.

Part II concerns itself with the applications of brass, plant practice in the handling of brass castings, sand, chill, and die; cleaning; rolling and forging; drawing, pressing and stamping of sheets; annealing. Richard Rimbach (11a) -B-

Equilibria between Iron and Nickel and Their Silicates Saturated with Silicic Acid (Die Gleichgewichte zwischen Eisen und Nickel und ihren an Kieselsäure gesättigten Silikaten). P. BARDENHEUER & E. BRAUNS. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf,* Vol. 17, No. 9, 1935, pages 127-132. The equilibria between Fe-Ni melts and Fe-Ni-silicates were determined at about 1600° C. by melting tests in a sand crucible. The distribution of Ni and Fe between metal melt and silicate slag conform, in a first approximation, to the ideal law of mass action although not only a double reaction between the silicious oxides occurs but also considerable amounts of Fe oxides exist in the slags. The oxide content is determined for the Fe rich melts practically only by the ferrous oxide and for the Ni rich melt by the Ni oxide of the silicate slags. The solubility of the Fe rich melts for ferrous oxide is influenced very little by Ni contents up to 50% and also the coefficient [O]/(NiO) for Ni rich melts is little changed by Fe contents up to 5%. The solubility of Ni oxide in Ni rich melts decreases with decreasing temperatures. The constitutional diagram FeO-NiO-SiO_2 is given for the solubility of solid SiO_2 in FeO-NiO mixtures at 1600° C. 7 references. Ha (11a)

The Properties of Some Special Bronzes. D. HANSON & M. A. WHEELER. *Journal Institute of Metals,* Vol. 57, June 1935, pages 265-284 (Advance Copy No. 704). Additions of Al, Mn, Al plus Mn, Fe, and Si were made to Cu-Sn bronzes. Rolling characteristics, mechanical properties, tendency to scale, and microstructures were determined. Alloys containing Al and consisting of a single solid solution rolled well either hot or cold. Alloys with a duplex structure could be rolled with difficulty. Annealed alloys possess good ductility. Maximum tensile strength of annealed alloys was 30 tons/in.^{2} for an alloy containing 4% Al and 5% Sn. Alloys containing 2% or more Al are fairly resistant to oxidation at high temperature, particularly if the cast surface is not damaged. Polished alloys are fairly resistant to tarnishing in air. The scale formed on heating is difficult to remove either mechanically or chemically. Mn has little influence on the rolling characteristics of alloys with 5% Sn. The alloys studied could be worked either hot or cold. Mn increases the softening temperature of the bronzes. Alloys containing both Al and Mn were difficult to cold roll unless they were first annealed. Al increases strength of Mn bronzes without affecting ductility appreciably. Alloys containing 5% Sn and up to 4% Fe could be rolled without difficulty. Fe up to 1.5% has little influence on tensile properties but 2% or more increases strength at expense of ductility. The Fe was uniformly distributed in the form of small particles in the solid solution. An alloy with 3% Si could be cold worked only with great difficulty, and one with 4% Si could not be worked either hot or cold. Si increases strength. 8 references. JLG (11a)

Tin Containing Aluminium, Manganese and Bismuth. D. HANSON & E. J. SANDFORD. *Engineering,* Vol. 139, Mar. 22, 1935, page 318. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 334R/3. VSP (11a)

The Inter-relation of Age-hardening and Creep Performance. Part I.—The Age-hardening of Nickel-silicon-copper Alloys. C. H. M. JENKINS & E. H. BUCKNALL. *Journal Institute of Metals,* Vol. 57, June 1935, pages 285-319 (Advance Copy No. 705). An investigation is reported of the hardening characteristics of Cu alloys containing 3 and 5% Ni plus Si in the atomic ratio 2 Ni : 1 Si. The work was carried on as a preliminary to the investigation of the interrelationship of creep and hardening characteristics. An alloy with 3% Ni plus Si when quenched from 900° C. undergoes age-hardening at temperatures of 300°-750° C. The maximum hardness is reached in more than 64 days at 400° C. and in less than 1 min. at 700° C. In general, a linear relationship exists between the logarithm of time and the reciprocal of the absolute temperature of attainment of maximum hardness. The maximum hardness is greater the lower the aging temperature. The attainment of maximum hardness is generally followed by softening. In an appendix consideration is given to points relating to the hardening of Cu-Ni-Si alloys and their comparison with information in the literature relating to other age-hardenable alloys. Particular attention is directed to the importance of the relationship between temperature and time of attainment of maximum hardness, which is shown to be of general application. A similar relationship applies to the attainment of maximum resistivity during aging. These relationships are regarded as confirming the commonly accepted theory of age-hardening. 38 references. JLG (11a)

Influence of Metallic Additions on Aluminum and Magnesium Alloys. A. S. LUGASKOV. *Legkie Metalli,* May 1935, pages 32-34. In Russian. Summary of published data. (11a)

The Effects of Thermic Treatment upon the Physical Properties of Aluminium Alloys. J. TOWNS ROBINSON. *Metallurgia,* Vol. 12, June 1935, pages 51-56. The properties of heat-treated forged and cast Al alloys are given. Importance is attached to the repeated impact resistance of the alloys and to the hardening of the heat-treated alloys on cold working. JLG (11a)

The Problem of Materials. II (Beiträge zur Werkstofffrage. II). E. RABALD. *Chemische Fabrik,* Vol. 8, Apr. 17, 1935, pages 139-145. The application of metals in chemical industry is discussed. The addition of Sb to Pb increases its strength, but reduces its workability and corrosion resistance. Addition of up to 1% Cu increases the corrosion resistance of Pb to cold HCl, but at 100° C. .2% Cu offers maximum resistance. Corrosion is also reduced by .1% Ag Cd_4. Hammering or rolling cuttings of Ag or Ni into the surface of Pb increases its resistance to hot concentrated H_2SO_4. Addition of .043% Te to Pb raises its tensile strength from 1.51 to 3.22 kg./mm.^{2} Te reduces the grain size, raises the recrystallization temperature, prevents intercrystalline fractures, raises the endurance limit and impact strength, and increases the corrosion resistance to H_2SO_4 and H_2O. Te-Pb can be cold worked. Pure Al has better corrosion resistance than its alloys. It is used in contact with rayon, acetic acid, HNO_3, food, bleaching materials, and for the transportation of NH_4OH, formaldehyde, gasoline and other materials. Al foil is used for heat insulation. Steel is coated with Al for protection against scaling. Al-Si alloys have higher strength than pure Al and better casting properties. They have good corrosion resistance against oils, fats, S, S compounds, and NH_4OH. Al-Mg alloys are used where sea water is encountered. 31 references. CEM (11a)

Diffusion of Hydrogen Through Aluminum. C. J. SMITHELLS & C. E. RANSLEY. *Nature,* Vol. 135, Apr. 6, 1935, page 548. H diffuses through Al above 400° C., thus proving that it is soluble in Al, contrary to previous conclusions. The rate is about the same as for H through Cu. CSB (11a)

Crystal Structure and Electrical Properties. VI. The 8 Principal Electrical Conductivities of Bi Crystals in a Magnetic Field (Kristallstruktur und elektrische Eigenschaften. VI. Die Acht Elektrischen Hauptleitfähigkeiten des Bi-Einkristalls im Magnetfeld). O. STIERSTADT. *Zeitschrift für Physik,* Vol. 95, June 17, 1935, pages 355-364. A mathematical development is presented to show the meaning of different electrical conductivities in a single Bi crystal in relation to its crystal structure for weak magnetic fields. FHC (11a)

Electric Conductivity of Hydronalium (Die elektrische Leitfähigkeit von Hydronalium). H. VOSSKÜHLER. *Aluminium,* Vol. 17, Aug. 1935, pages 415-418. The electric conductivity of hydronalium, an Al alloy with up to 12% Mg and 0.1-0.4% Mn, depends largely on whether the structure is homogeneous or heterogeneous, and this again depends on the rate of cooling. Homogeneous structures are obtained by quenching, heterogeneous structures are formed during slow cooling as the solubility of Mg in Al decreases rapidly from 15.3% at the eutectic temperature of 451° C. to about 2.8% at room temperature so that Mg can be precipitated. The structure of alloys with more than 2.8% can, therefore, be either homo- or heterogeneous according to the rate of cooling. The specific resistance of quenched alloys increases from 3.27 x 10^6 ohm cm. for 0% to 9.65 for 11.8% Mg, while the temperature coefficient decreases with increasing Mg content. Cold working has no effect on electric conductivity. Ha (11a)

Gold-Cobalt Resistance Alloys. JAMES L. THOMAS. *Bureau of Standards Journal of Research,* Vol. 14, May 1935, pages 589-593. Au-Co alloys containing 0.75 to 5% of Co have been prepared and investigated to determine if they are suitable for use in the construction of electrical resistance units. The temperature coefficient of electrical resistance of the alloys containing from 1.5 to 2.5% of Co is small at room temperatures, but the thermoelectric power of the alloys against Cu is large. These alloys were found to be inferior to Au-Cr alloys of about the same proportions. WAT (11a)

New Corrosion-resisting Material. *Shipbuilding & Shipping Record,* Vol. 46, July 1935, page 17. The results of various tests on Tungum alloy are given and show the maximum stress to vary from 15.96 tons/in.^{2} for castings to 46.3 tons/in.^{2} for hard rolled material. The fatigue value of soft rolled material in air is ± 15 tons/in.^{2} and in sea water ± 11.5 tons/in.^{2} The corrosion of the alloy is practically negligible under total immersion and electrolytic conditions, and the thermal conductivity varies from 0.17 c.g.s. at 50° C. to 0.28 c.g.s. at 450° C. JWD (11a)

Which Alloys for Die Castings? HERBERT CHASE. *Product Engineering,* Vol. 6, Oct. 1935, pages 379-382. Nominal compositions, properties and fields of use of 2 Zn base, 6 Al base, 1 Mg, 3 Cu, 2 Sn and 3 Pb base alloys preferably used for die casting are described. The Mg alloy with 10% Al is the lightest of all, sp. gr. 1.81, used in aircraft and portable machines. Sn alloys are used for parts in contact with foods. The proper selection of an alloy is discussed in general. Ha (11a)

Columbium and Tantalum. CLARENCE W. BALKE. *Industrial & Engineering Chemistry,* Vol. 27, Oct. 1935, pages 1166-1169. Paper presented in the Symposium on Recent Advances in the Chemistry of the Rarer Elements before the Division of Physical and Inorganic Chemistry at the New York Meeting of the American Chemical Society, Apr. 1935. This paper describes the method of separation of the metals, hydraulic pressing into bars, and heat-treatment in vacuum furnaces to produce ingots. The various modes of working the metals, fabrication, methods of hardening, are described, as well as uses of Ta and Cb in vacuum tubes and, as carbides, in producing tool bits. MEH (11a)

A New Steam Resistant Alloy (Über eine neue, gegen Wasserdampf beständige metalllegierung). H. Kalpers. *Feuerungstechnik,* Vol. 22, May 15, 1934, pages 61-62. The corrosion resistance of austenitic Cr-Ni steels is attained or even exceeded by an alloy containing 88.10% Cu, 8.70% Al and 3.05% Fe. It can be rolled, drawn, hardened and is practically resistant against steam, sea-water and many chemical reagents. Experiments by the Verein zür Überwachung der Kraftwirtschaft der Ruhrzechen, Essen, in HCl, acetic acid, thio-sulphate, NH_4Cl proved that the corrosion attack stops after a certain time. The new alloy has been utilized in steam turbines, pumps, condensers, fittings, ship-building, chemical, food, and mining industry. Physical tests at the Vereinigte Technische Staatslehranstalten Dortmund yielded: 67.1 kg./mm.^{2} tensile strength, 25-35% elongation, $\sim$33% reduction of area, 190-195 Brinell hardness, 12.5-13.5 mkg./cm.^{2} impact strength, 22.6 kg./mm.^{2} fatigue strength at over 15 million cycles, thermal expansion of a 500 mm. rod = 0.0000157 (steel = 0.000011), and thermal conductivity = 120 cal./m.hr./°C. (steel = 56 cal./m.hr./°C.
WH (11a)

The Effect on the Physical Properties of Bending Copper Wire of Different Grain Size. L. B. Barker & C. A. Bailey. *Wire & Wire Products,* Vol. 10, Sept. 1935, pages 375-377, 380, 452. Experiments with small amounts of cold working (e.g. when soft wire is passed over sheaves in operation after annealing) seemed to indicate a distinct relation between grain size, Rockwell hardness and resistance to bending or springiness, while no close relationship could be stated for these qualities and elongation and tensile strength. The elongation test does, therefore, not offer any reliable indication of the changes occurring when annealed Cu wire is slightly cold worked by bending or elongation. Bending always increases stiffness inversely with initial hardness and seems to be independent of the amount of previous reduction. Increasing the annealing temperature to approx. 700° C. decreases stiffness developed under all conditions, and wire annealed at 800° C. showed higher bend test values than when annealed at 700° C. Temperature of minimum stiffness was not determined, this seems to vary with the amount of previous reduction and composition of the Cu. Wire which had been annealed at temperatures close to the recrystallization point may be satisfactory as regards tensile strength and elongation but yet be entirely unsatisfactory for many uses.
Ha (11a)

Rhodium Surfaces for Metal Reflectors. B. Bart. *Product Engineering,* Vol.6, Aug. 1935, pages 308-309. High optical accuracy in metal reflectors can be obtained by electrolytically depositing Cu or Ni on a mold and plating it with Rh. The Rh surface is many times harder than Ag, non-oxidizing, resistant to heat, and unaffected by industrial or chemical fumes and products of combustion. Rh is easily deposited with a bright finish and does not require polishing. It is particularly useful as reflector in arc lamps as droplets thrown on the surface do not attach themselves to the reflecting surface because of the rapid thermal absorption of the metal, and heat does not impair the surface even at temperatures that would destroy a glass mirror. The Rh surface is not color selective in its reflection, and the reflectivity in the ultraviolet range is much higher than for glass, and higher in ultraviolet and infrared than for any other metal surface.
Ha (11a)

Effect of Copper in Malleable Iron. C. H. Lorig & C. S. Smith. *Transactions American Foundrymen's Association,* Vol. 6, Feb. 1935, pages 211-226; *Foundry Trade Journal,* Vol. 52, Jan. 1935, pages 93-95. In experiments carried on with Cu-bearing malleable iron certain advantages were found over ordinary unalloyed malleable cast iron. Cu is easily soluble either with the charge or in the ladle. at least 3% goes into solution. Under 0.50% Cu has little effect on the physical properties, but from 0.70 to 1.25 to 1.50% improved the endurance strength. The mechanical properties of Fe containing more than 0.70% Cu are improved by precipitation-hardening. Cu does not change the fluidity or shrinkage of malleable Fe, nor does it increase cracking, has no marked influence on the structure but accelerates graphitization considerably, both in the first and second stages. Cu reduces the susceptibility to intergranular embrittlement.
CEJ + AIK (11a)

Service Characteristics of the Light Metals and Their Alloys. *Steel,* Vol. 96, Feb. 11, 1935, pages 35-39; Feb. 18, 1935, pages 36, 38, 40, 43; Feb. 25, 1935, pages 31-34. See "Light Metals and Alloys," *Metals & Alloys,* Vol. 6, June 1935, page MA 246L/5.
MS (11a)

Tantalum Carbide in Hard Alloys. L. P. Molkov & A. V. Khokhlova. *Redkie Metallui,* Vol. 4, Jan.-Feb. 1935, pages 10-23. In Russian. Ta and Ta_2O_5 were heated with C at 1600° C. for 25 hours. The carbide obtained contained 6.2 to 6.9% C, had a lattice parameter of 4.41 to 4.43 A.U., and had a yellow to yellowish-gray color. The carbide obtained from Ta_2O_5 was purer and of finer grain than that obtained from Ta. TaC is soluble in Co up to 6%; at 35% TaC a eutectic which melts at 1445° is formed. In Ni, TaC is soluble up to 20% and above this a new phase appears which was not investigated. Alloys of TaC with Co, Ni, and Fe + Mo were prepared, micrographically examined and tested for cutting properties. They had a hardness up to 92 Rockwell "C." Those prepared with a binder of 63% Fe and 37% Mo were superior to those with a Co or Ni binder. These alloys can be easily prepared by the ordinary means used in powder metallurgy.
HWR (11a)

Zinkan, A New Material (Zinkan, ein neuer Werkstoff). J. F. Kesper. *Die Umschau in Wissenschaft und Technik,* Vol. 39, Mar. 17, 1935, page 236. Zinkan is Al-coated Zn. The metals are combined by rolling at elevated temperatures. The duplex material shows excellent deep-drawing properties and is resistant towards many organic acids, dry and moist air, Cl, H_2S and waste gases. It is stronger than Zn and more resistant in outdoor exposure. Annealing at 300° C. increases strength due to diffusion of Zn into Al. Zinkan has a Cr-Ni-like luster and in many cases replaces Ni-brass, Al and Cu sheets. It is 16%, 20% and 25% lighter than brass, galvanized Fe and Cu or German silver sheets respectively. Zinkan can be worked easily, welded, soldered, polished, colored, Cr-plated, etc.
WH (11a)

Thermo-electric Effect and the Supra-conducting State. E. F. Burton, F. G. A. Tarr & J. O. Wilhelm. *Nature,* Vol. 136, July 27, 1935, page 141. No thermoelectric effect was detected between Pb and Sn when both junctions were in the supra-conducting state, but when either junction is above the supra-conducting range of temperature of one of the metals the effect is present.
CSB (11a)

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11b. Ferrous

V. V. KENDALL. SECTION EDITOR

Magnetic Properties of Sheet Made of Electrolytic Iron (Die magnetischen Eigenschaften elektrolytisch erzeugter Eisenbleche). O. DAHL, F. PAWLEK & J. PFAFFENBERGER. *Archiv für das Eisenhüttenwesen,* Vol. 9, Aug. 1935, pages 103-112. Sheet made directly from electrolytic iron gave good mechanical and magnetic properties. Recrystallization rather than H_2 removal causes softening. Such sheet has high induction, low coercive force and hysteresis, and is insensitive to aging. In agreement with Yensen's results the coercive force and hysteresis decreased in thicker sheet, and particularly in larger grained sheet. For use in transformer sheet 0.5 to 1% As cut down eddy current losses materially. SE (11b)

Steels Manufactured in France (Les Aciers de Fabrication Française). *Métaux et Machines (Science et Industrie),* Vol. 19, July 1935, pages 247-251; Aug.-Sept. 1935, pages 297-304. Reviews corrosion resisting steels which are classified as follows: (1) semi-resisting steels of the low Cu type, (2) stainless steel, (3) non-rusting steels, (4) heat resisting steels. July number is devoted to first class and Aug.-Sept. number to second class. Both discuss effect of composition, physical properties, heat treatment, mechanical strength, resistance at high temperature, corrosion resistance, machining, applications. FR (11b)

Comparison of Nickel and Nickel-Chromium Steels with Ordinary Carbon Steels (Comparison des aciers au nickel et nickel-chrome avec les aciers ordinaires au carbone). A. LEBLANC. *Métaux,* Vol. 10, May 1935, pages 131-134. General comparison of physical properties of steels based on mechanical tests. GTM (11b)

Tool Steels (Les aciers à outils). ANDRÉ MICHEL. *Métaux,* Vol. 10, Jan. 1935, pages 3-21; Apr. 1935, pages 88-100. 7 references. A comprehensive survey of tool steels, their treatment and characteristics. GTM (11b)

Welded Pressure Vessels Require New Steels. L. P. McALLISTER. *Industry & Welding,* Vol. 6, June 1935, pages 14-16. Low alloy steels with 0.25% C max., 2% Ni steel with less than 0.2% C, Mn-V steels (used by the U. S. Navy) with Mn max. 1.45%, V 0.08%, C under 0.18%, C-Mo steels with Mo between 0.4-0.6%, C under 0.25%, and "Cromansil" with 0.3-0.6% Cr, 1.05-1.40% Mn, 0.6-0.9% Si, and Ni- and Cr-clad steels are briefly reviewed. Ha (11b)

Notch-Sensitiveness of Cast Iron Under Impact Stress (Ueber die Kerbempfindlichkeit von Gusseisen bei stossartiger Beanspruchung). E. VON RAJAKOVICS. *Giesserei,* Vol. 22, Sept. 13, 1935, pages 458-459. Contradictions in the results of former investigators are pointed out and control tests described briefly. The discrepancies disappear and are explained if the friction losses in the test are not taken into account; the specific impact energy for notched bars is apparently 16.6% greater than for unnotched bars; when the friction losses are taken into consideration the figure for notched bars was 3.2% smaller than for unnotched bars. It is concluded that while cast Fe is considered to be practically notch-insensitive to alternating tensile stresses it is fairly sensitive against impact stresses. 7 references. Ha (11b)

High-manganese Steel. L. SANDERSON. *Metallurgia,* Vol. 12, Oct. 1935, pages 171-172, 176. Discusses properties and uses of Hadfield Mn steel. JLG (11b)

Change in Mechanical Properties of Corrosion-resistant Steel Due to Cold-Working (Modification par ecrouissage des caracteristiques mecaniques des aciers resistant a la corrosion). G. VERY. *Metaux,* Vol. 9, Oct. 1934, pages 452-454. Increase in Ni content (0.10% C, 18% Cr, 8% Ni) decreases notably the hardness due to cold working. With Cr less than 18% a stable austenite is formed while with over 20% there is a partial formation of ferrite which hardens a little by cold-working. Mo, W, Si and Ti increase the hardness as well since they form ferrite which diminishes the effect of cold-working. GTM (11b)

Aluminum in Cast Iron (Influence des Additions d'Aluminium sur les Propriétés des Fontes Ordinaires). MARCEL PLOYÉ. *La Fonte,* July-Aug.-Sept. 1935, pages 658-664. Second and third parts of an article on the effect of Al additions up to 18% in 3 different types of cast Fe. The alloys having an Al content of 8% or more were very resistant to oxidation at high temperatures and to corrosion by salt solution. The 18% Al alloy was non-magnetic. 18 references. WHS (11b)

Aluminum Cast Irons (Les Fontes a l'Aluminium). MARCEL PLOYÉ. *Bulletin de l'Association Technique de Fonderie,* Vol. 9, Aug. 1935, pages 257-277. Paper presented before the A. T. F., Mar. 20, 1935. Additions of Al from 0.2 to 0.5% in cast Fe did not have any appreciable beneficial effect on the metal unless it was oxidized. Porosity may be caused by such additions. Production of alloys of cast Fe with high Al content is difficult because of the large volume of kish and complex Fe-Al oxides formed. Hardness, transverse and shear strength, dilatometric properties, heat and corrosion resistance are discussed. WHS (11b)

Low Carbon, High-Tensile Steels. Part III. A. WILLIAMS. *Industry & Welding,* Vol. 7, Nov. 1935, pages 44-45. A new low alloy steel, Cor-Ten, has the composition C 0.10% max., Mn 0.1-0.3%, P 0.1-0.2%, S 0.05% max., Si 0.5-1.0, Cu 0.30-0.50%, Cr 0.5-1.5%. The yield point, rolled and welded, is about 50,800 lbs., tensile strength 74-75,000 lbs., reduction of area 0.84 rolled, 0.765 welded. The corrosion resistance in air is about 4-6 times that of low C steel. Ha (11b)

Magnetic Hard Iron-Nickel-Copper Alloys (Über magnetischharte Eisen-Nickel-Kupfer-Legierungen) Preliminary Report. H. NEUMANN. *Metallwirtschaft,* Vol. 14, Sept. 27, 1935, pages 778-779. The existence of Fe-Ni-Cu alloys with high magnetic and low mechanical hardness, which was recently imported by Dahl Pfaffenberger & Schwartz (*Metallwirtschaft,* Vol. 14, Aug. 23, 1935, pages 665-670), is confirmed. Higher values for coercive force, for a slightly different composition, than the maximum reported by the other authors were found, also a different effect of heat treatment. The complete results are to be published later. CEM (11b)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Alloy Steels for Heat Recuperators (Aciers Spéciaux pour Echangeurs Thermiques). PIVETEAU & COLVEZ. *Chaleur et Industrie,* Vol. 16, Aug. 1935, pages 381-386. First studies different kinds of corrosion at high temperatures: (1) Oxidizing atmosphere: 4-6% Cr steels are used when a high heat resistance is not needed, i.e. up to 650° C. 12-14% Cr steel can be used up to 800° C. The best heat resisting steels contain 18-35% Cr and can be used within the range 900°-1150° C. Si and Al additions are sometimes made to Cr steels in order to improve resistance to oxidation. These elements can impart brittleness in the cold state. When Cr steels must have a high mechanical resistance at high temperatures additions of 8-25% Ni are made. (2) Reducing atmosphere: 30% Cr steels behave as well in reducing atmosphere as in oxidizing atmosphere. When CO atmospheres are encountered there is a carburization of metal and the melting point is lowered. C can combine with Cr so that the base metal becomes low in Cr. (3) Cr steel with Zr additions can resist atmospheres containing S. Ni content must not be too high in steel having to resist atmosphere containing S. The higher the Ni the higher the Cr content must be. (4) When atmospheres contain N, steel must not contain Al. (5) If atmospheres contain H which has a decarburizing action, 18/8 Cr-Ni steels give good results. When these steels are too expensive, 4-6% Cr steel with 0.5% Mo, 0.5% V or 0.3% Ti can be used. The last section reviews (a) mechanical properties at high temperature, (b) heat conductivity, (c) coefficient of expansion, (d) stability of structure at high temperatures, (e) weldability. FR (12)

Effect of Phosphorus on Mechanical Properties of Gray Iron at Elevated Temperatures (Der Einfluss von Phosphor auf die mechanischen Eigenschaften von grauem Gusseisen bei höheren Temperaturen). M. PASCHKE & F. BISCHOF. *Giesserei,* Vol. 22, Sept. 13, 1935, pages 447-452. After a review of the work done previously in this field, new investigations are described which were to determine relations between tensile strength, Brinell hardness and specific impact energy for temperatures up to the pearlite line and beyond. In order to determine clearly the effect of P in this respect the tests were made under similar conditions changing only P. The results which are described in detail show that tensile strength and hardness at elevated temperatures depend on the P content and on the ratio Mn-Si; the absolute amounts of the 2 latter elements are, of course, also important as they determine the strength. No relation could be found, in spite of constant conditions, between P content and creep strength. 14 references. Ha (12)

An Investigation of the Nature of Creep Under Stresses Produced by Pure Flexure. H. J. TAPSELL & A. E. JOHNSON. *Journal Institute of Metals,* Vol. 57, Aug. 1935, pages 387-405 (Advance Copy No. 712). Stresses and strains arising when a material is subjected to bending moments under conditions that produce creep were investigated. For experimental reasons, Pb of commercial purity was used because creep could be produced at room temperature. Apparatus was constructed in which a beam of Pb was subjected to uniform bending moment, and measurements of creep of the beam were recorded. The whole equipment was in a chamber held at constant temperature. Tensile creep tests of the Pb were also carried out to provide stress-strain data for calculation of stresses in the beam. It was found that in the case of the Pb beam creeping under stresses produced by pure flexure plane sections continued to remain plane; the redistribution of stresses arising from creep is complete within ½ hr. after application of bending moment and the stresses continue unaltered with time; and that the behavior of the beam under flexure may be computed solely from the relations between tensile stress and rate of strain corresponding to any period of tensile creep testing on the material of the beam. JLG (12)

The Effect of Elevated Temperatures on the Strength and Dimensional Stability of Certain Aluminum Alloys Used in Aircraft. RICHARD R. KENNEDY. *Metal Industry,* London, Vol. 46, Feb. 8, 1935, pages 169-170; Mar. 8, 1935, pages 281-282. Abstract of a paper presented at the Non-Ferrous Foundry Convention of the American Foundrymen's Association. See *Metals & Alloys,* Vol. 6, June 1935, page MA 250R/7. HBG (12)

The Behaviour of Mild Steel Under Prolonged Stress at 300° C. Part II.—Experiments on Concentrated Stress in Notched and Drilled Specimens. C. H. M. JENKINS. *Iron & Steel Institute,* Advance Copy No. 10, Sept. 1935, 7 pages. Tests on specimens subjected to stress locally concentrated at drilled holes and machined notches have been in operation for 5 years. Although considerable local deformation has occurred at the points of stress concentration, no cracking has developed, indicating that local stresses in the absence of chemical accelerating agents are insufficient to cause cracking. JLG (12)

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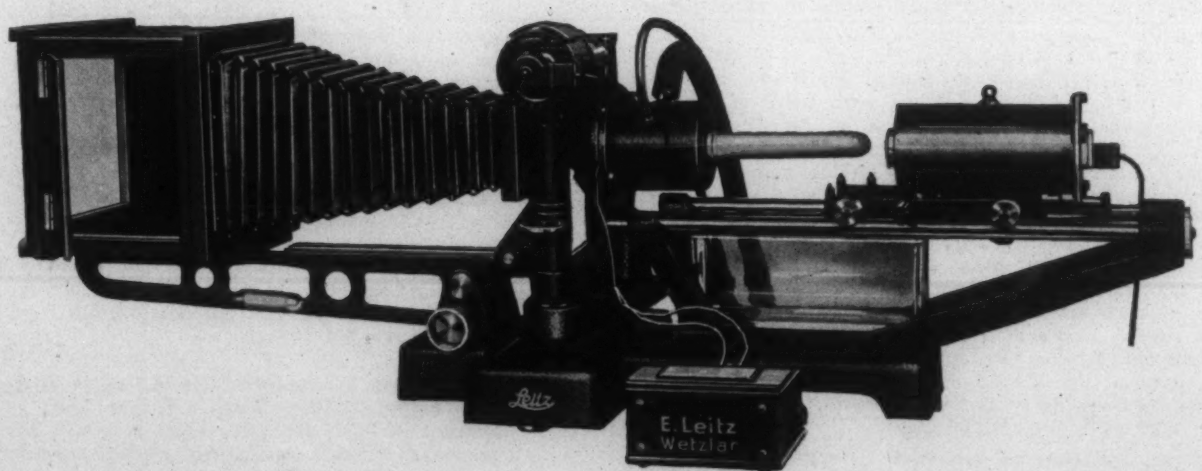

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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

A Mathematical Theory of Corrosion. Correlation of Corrosion with Age and Soil Index for Steel Mains. J. F. Brennan. *Gas Age-Record,* Vol. 75, Apr. 13, 1935, pages 359-364. Paper presented at Spring Meeting of Technical Section, Pacific Coast Gas Association, Los Angeles, Calif. Mar. 1935. From data of the U. S. Bureau of Standards and from other data, the author develops equations for soil corrosion. For equivalent conditions of moisture, depth of pitting on bare steel pipes may be expressed as

$$y = [A + Bz] \log \left(\frac{x}{h} + 1 \right)$$

where, y = depth of pitting, x = age in years, z = soil corrosivity index (Corfield). The Corfield index is particularly applicable to alkali soils such as are found on the western coast. Constants A and B may be evaluated by mathematical methods, from observations and laboratory test data. These data should include for each inspection: (1) age of pipe, (2) micrometer measurements of several of the deepest pits, to thousandths of an inch (adjusted if necessary and possible for size of sample), (3) laboratory test of soil, (at each inspection location) for Corfield index, (4) description of paving, (5) notation of all other conditions which might influence corrosion, that is, moisture visible, adjacent industry, streams, gardens, vegetation, kind of soil, depth of pipes, topography, etc., (6) mean annual precipitation for the locality. With this information, the inspection records can be grouped so that the proper set of constants for the equation may be computed for each group. Having determined the constants for the equation, some statistical measure of the reliability of the equation should be derived. The standard error or the probable error should be computed, as should also the index of correlation. Only with these quantities can the probable accuracy of an estimate from the equation be forecast. VVK (13)

Sucker Rod Fatigue Changes with the Nature of Corrosive Elements in Oil. F. B. Bayless. *Oil & Gas Journal,* Vol. 34, Aug. 15, 1935, pages 26, 28. 30. Sucker rod service is divided into 3 general classes, namely: in wells where stress only is to be considered; corrosion in addition to stress; stress in addition to the severe embrittling action of H_2S gas in conjunction with corrosive fluids. Methods of investigation, the effect of notches on endurance limit, laboratory investigation with synthetic well fluids and the requirements of a satisfactory rod are discussed. The following rods are offered. For stress conditions: plain carbon (.35-.50%); C-Mn (1.20 and 1.80% Mn); Cr-Ni (.90-.75%); Cr-Mo (.65-.20%). For sulphide and non-sulphide corrosive conditions: wrought iron; 3% Ni wrought iron; Ni-Mo steel (1.75%-.25%); .04% C-Ni-Mo (3.50%-.22%); C-Mn (.40%-1.20%); Cr-Ni (.90%-.75%). VVK (13)

Corrosion of Light Alloys (La Corrosion des alliages ultra-legers). P. Bastien. *Metaux, Aciers Spéciaux, Métaux et Alliages,* Vol. 9, Oct. 1934, pages 408-414. In humid atmosphere Mg takes on a white layer of porous and non-protective $Mg(OH)_2$. Addition of Al to the saturation content diminishes the Mg tendency to corrode, while Cu which does not enter into solid solution increases the corrosion. The light alloys which resist corrosion are Mg-Mn and Mg-Al-Mn, manganese content being about 1.5%. As protective means against corrosion, the light alloys are chemically treated to attain a protective film. To do this, pieces are cleaned with dilute HNO_3 solution, washed, then immersed for several hours in a bath of alkaline chromate and bichromate diluted and heated at 90° C. This treatment gives an adherent complex film yellow in color, which protects the metal. Sherardizing, calorizing or Schoop process do not help prevent the corrosion of light alloys. GTM (13)

The Control of Corrosion in Air-Conditioning Equipment by Chemical Methods. C. M. Sterne. *Preprint American Society for Testing Materials,* June 1935, 10 pages. Corrosion attack of the metallic parts of air-conditioning systems can be so severe that perforation of ferrous sheets and pipes may take place in as short a time as 4 months if the wash water or condenser water is not chemically treated. Practically every type of corrosion attack is common to these systems. Service corrosion tests and analyses of the recirculated water show very clearly the causes and degree of severity of that attack. The tests also show the degree of protection that may be obtained by proper chemical treatment. Corrosion tests have been run by the author in over 200 separate air-conditioning systems, handling both comfort and industrial conditioned spaces in many types of industry and in various cities throughout the United States. Representative cases are reported. Treatments used included sodium dichromate, sodium hydroxide, sodium silicate, sodium carbonate, trisodium phosphate, tannin and various mixtures of these. Sodium dichromate was found to be the most effective. Electrolytic protection methods have not been successful due primarily to the size of the equipment and the difficulty of finding proper anode materials and so placing them as to distribute the current adequately. VVK (13)

Corrosion from Products of Combustion of Gas—Part I. Preliminary Investigations. 33rd Report of the Joint Research Committee of the Institution and Leeds University. James W. Wood & E. Parrish. *Institution of Gas Engineers, Communication* No. 76, Oct. 1933, 45 pages; *Gas Journal,* Vol. 204, Nov. 15, 1933, pages 502-505; Dec. 13, 1933, pages 778-779; Supplement, Nov. 1, 1933, pages 2-4. The S acids formed by the combustion of S compounds in gas are the main cause of corrosion, but the situation is complicated by the presence of oxides of N and H_2O vapor produced during combustion. Using gas containing 25-30 gr. of S/100 cu. ft., liquid condensates from a number of appliances contained 12-100% of the S in the gas burned. With apparatus resistant to corrosion, S retention was low, suggesting that the S in the flue gases was mainly SO_2. The higher S invariably was associated with the presence of sufficient dissolved metal to fix the S as sulphite or sulphate, i.e., high S retention was concomitant with corrosion. The condensates also contained nitrates. Solid corrosion deposits from the combustion chambers of a number of typical gas appliances consisted mainly of sulphates or basic sulphates of the metals used, except for Fe, when the metal removed was much in excess of that necessary to combine directly with the S acids. Sulphites and carbonates were present only in minute amounts; there were no nitrates, although NH_3 salts always were found. AHE (13)

Third Report of the Corrosion Committee of the British Iron & Steel Institute. *Iron & Coal Trades Review,* Vol. 130, May 3, 1935, page 760; *Engineer,* Vol. 159, May 10, 1935, page 483; *Engineering,* Vol. 139, May 3, 1935, page 460; May 17, 1935, page 524. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 336R/1. Ha + LFM (13)

Cathodic Protection of Pipe Lines from Soil Corrosion. Scott Ewing. *Gas Age-Record,* Vol. 73, Mar. 2, 1935, pages 179-182; Mar. 9, 1935, pages 219-222; Mar. 16, 1935, pages 239-242; Mar. 23, 1935, pages 261-264. Report of the sub-committee on Pipe Coatings and Corrosion of the American Gas Association. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 416L/1. VVK (13)

Anomalies Observed in the Rate of Corrosion of Zinc. J. E. Maconachie. *Metal Industry,* London, Vol. 45, Nov. 2, 1934, pages 418-420. Paper presented before the Electrochemical Society, Sept. 1934. See *Metals & Alloys,* Vol. 6, Oct. 1935, page 419L/8. HBG (13)

Zinc and Its Alloys from the Point of View of Corrosion (Le zinc et ses alliages au point de vue de la corrosion). R. Cazaud. *Metaux,* Vol. 9, Oct. 1934, pages 440-444. Zn-Al alloys resist corrosion by a number of organic agents. A 10% Al, 0.5% Sb, Zn alloy is not attacked by benzene, toluene, xylene, acetone, ethyl alcohol, xylol or water. GTM (13)

Heat Resistant Materials (Zunderfeste Werkstoffe). C. H. Daeschle. *Montanistische Rundschau,* Vol. 27, Oct. 16, 1935, pages 7-8. Brief discussion of various surface coatings on Fe and steel to make them heat resistant, such as calorizing, alumiting, and spraying with Al. Industrial applications of Al-covered Fe include superheaters in boiler plants, exhaust pipes for explosion motors, melting pots, retorts, case-hardening boxes, heat exchangers, Diesel motor parts, pyrometer tubes, rolls, cylinder heads, and equipment in glass plants. Recently it has been found that the protective action may be greatly increased by using hard metals such as Cr and W instead of Al. BHS (13)

The Corrosion of Tin and Aluminum. *Tin,* Sept. 1935, pages 4-6. The relative rates of corrosion of Sn and Al when used for cans in preserving foods were found to be almost the same over a range of acidity, but at high acidities there was a marked increase in the corrosion of Sn. During the corrosion of Sn there was a decrease in the volume of gas present owing to the absorption of O, while in the case of Al there was an increase, due to the evolution of H. This indicates that the corrosion of Sn would cease when the O in a can was exhausted whereas with Al it would continue until all the acid was neutralized. Methods of testing with citric acid are described. Ha (13)

Hard-Facing in a Textile Mill. *Oxy-Acetylene Tips,* Vol. 14, Oct. 1935, pages 227-228. The value of wear-resisting alloys for hard-facing parts especially subject to wear is pointed out. Ha (13)

Silver Alloys Resistant to Blackening by Sulphurization (Alliages d'Argent Résistant au Noircissement par Sulfuration). H. Forestier. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 589-591. A study of Ag alloys where Cu is replaced by Cd, Mn, As, or Sb, permits the author to obtain Ag alloys which have a better resistance to S than alloys now in use. MAB (13)

Protective Films on Ferrous Alloys. Influence of Chloride Ion Upon Electromotive Behavior. Florence Fenwick. *Industrial & Engineering Chemistry,* Vol. 27, Sept. 1935, pages 1095-1099. Instead of the usual method of testing protective films on ferrous alloys, a new method is presented. It consists essentially of an electrometric titration wherein a chloride solution is slowly added to the solution in which the metal is immersed. The metal, with its film or coating, acts as one electrode, and the other is a suitable reference electrode. A sudden change in potential marks an abrupt change in the character of the metal electrode. The essentially reproducible differences in behavior of various films seem to show that the method offers a means of characterizing the film on the metal, with respect to its permeability to chloride ions and possibly therefore, to other ions, since chloride ion is one of the most active, as well as the most prevalent of all ions in corrosion processes. MEH (13)

Corrosion Problems in Shipbuilding (Die Korrosionsprobleme Schiffbau). *Schiffbau, Schiffahrt & Hafenbau,* Vol. 36, July 15, 1935, pages 226-227. See "The Corrosion Problems of the Naval Architects," *Metals & Alloys,* Vol. 6, July 1935, page MA 304L/9. WH (13)

Subcutaneous Effects During the Scaling of Steel. R. Griffiths. *Iron & Steel Institute,* Advance Copy No. 7, Sept. 1935, 5 pages; *Iron & Coal Trades Review,* Vol. 131, Sept. 20, 1935, page 436. The formation of globules and spots below the steel surface when oxidized under certain conditions is attributed to easily oxidized elements in the steel. To prevent the formation of such globules an excess of deoxidizing agents, such as Al, should be avoided. JLG + Ha (13)

Intercrystalline Corrosion of Austenitic Nickel-Chromium Steels (La Corrosion Intercristalline des Aciers Austénitiques Nickel-Chrome Résistant à la Corrosion). Eduard Houdremont & Paul Schafmeister. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 536-546. Use of non-oxidizing steels containing Ni and Cr has been universal. The role of carbides in intercrystalline corrosion caused by welding has been studied and means to avoid such trouble outlined. MAB (13)

Accelerated Marine Corrosion Tests (Quelques Remarques au Sujet des Essais Accélérés de Corrosion Marine). A. Herzog & G. Chaudron. *Chimie et Industrie,* Vol. 31, Special No., Apr. 1934, pages 572-574. Studies of marine corrosion are more and more numerous, but there are many different results obtained in different laboratories. There are two important factors: the amount of dissolved O and the composition of the salt solution. MAR (13)

Protection Against Corrosion—the Effect of Electrolytic Products (Le protection contre la corrosion par la mise en jeu d'actions electrolytiques derivantes). R. Lecoeuvre. *Métaux,* Vol. 9, Oct. 1935, pages 520-525. The presence of Zn or Cd on a material assures a certain protection in its immediate vicinity by virtue of its electrolytic effect. GTM (13)

Corrosion Tests of Metallurgical Products (Les essais de corrosion des produits metallurgiques). R. Cazaud. *Métaux,* Vol. 9, Oct. 1934, pages 473-485. 18 references. French Aeronautic Commission has accepted the following types of tests for corrosion: plates 4 mm. thick, wire 2.5 mm. diameter and sheets 1 mm. thick. All samples should be prepared for corrosion tests by removing the scale or the protective films. The corrosion tests are classified as follows: (1) continuous immersion, (2) alternate immersion, (3) spraying. As methods of measuring the corrosion: (1) visual observation of sample, (2) gravimetric—loss in weight, (3) calorimetric—increase in temperature, (4) volumetric—measuring gases evolved, (5) mechanical—measuring the variation in mechanical properties, (6) electric—measuring emf of solution, pH, (7) micrographic method. As total immersion tests there are: Prot-Goldowsky setup in which fresh liquid is supplied from top; the Thyssen-Bourdouxhe type in which there is a continuous circulation of some liquid, and the Chaudron & Herzog bomb under pressure. In partial immersion there is a greater corrosion attack at the liquid level. For alternate immersion there is the Rackwitz & Schmidt setup developed in Germany. The well-known salt spray is also discussed. Testing methods of protective coatings are as follows: for Zn coating, immersion in a neutral $CuSO_4$ solution (20 g. salt in 80 cc. water) with addition of CuO. By decomposition of $CuSO_4$ by Zn, a precipitate of Cu is produced which can be washed with H_2O. The continuity of a coating is tested with a neutral chemical product which gives a colored reaction with the base metal. A simple test for the electrodeposited Ni or Cr consists in immersing the sample in a solution (1 g. potassium ferricyanide, 10 g. NaCl in 1000 cc. H_2O). In few minutes blue spots appear where the base metal is exposed. GTM (13)

Influence of the Material on the Life and Economy of Pipes for Pneumatic Packing (Der Einfluss des Werkstoffes auf die Lebensdauer und Wirtschaftlichkeit von Blasversatzrohren). K. Bax. *Glückauf,* Vol. 71, Sept. 21, 1935, pages 913-917. Wear of materials used to fill worked mines (gobbing) by earth and other material under air pressure is reviewed as it is indicated in literature, and curves of wear of hardened and not hardened steel pipes are given. The most economical seems to be at present to use a high-grade hardened steel pipe with an outside mantle of softer material; the hardened pipe has a wall thickness of 4-5 mm., the outside softer material of 2-3 mm. A table shows the costs for wear for each $m.^3$ of gobbing material and 100 m. pipe length for 13 different materials. Ha (13)

Hard Facing Steam Valves. *Oxy-Acetylene Tips,* Vol. 14, Aug. 1935, pages 178-180. Hard facing of valve seats and other parts subject to heavy wear at high temperatures with a non-ferrous, Co-Cr-W, alloy is of particular advantage as the material maintains its strength and hardness at elevated temperatures, is extremely abrasion-resistant and corrosion-resistant, and also resistant to SO_2 and SO_3. A number of examples show its applications and the procedure of welding it on. Ha (13)

Preserving the Safety, Longevity and Efficiency of Cracking Equipment. O. E. Andrus. *Oil & Gas Journal,* Vol. 34, Aug. 1, 1935, page 34. Advocates use of high Cr and Cr-Ni lining on C steel for oil cracking equipment. VVK (13)

Corrosion in California Refineries. J. C. Albright. *Refiner & Natural Gasoline Manufacturer,* Vol. 14, Mar. 1935, pages 114-117; Apr. 1935, pages 180-184. Corrosion, as it affects equipment in refineries, can be classified as follows: (1) Corrosion encountered while cracking. (2) Corrosion caused by corrosive agents in the stocks charged to low pressures, low temperature units used in simple distillation or skimming processes. (3) Exterior corrosion of plant pipe lines and corrosion of condensing and cooling equipment either tube and shell or atmospheric units coming into contact with salt or fresh water. Most important factors affecting high temperature corrosion are (1) the kind of corrosive agent encountered while cracking; (2) kind of metals from which equipment is fabricated; (3) the processing temperatures involved; (4) concentration of corrosive agent responsible; (5) combination of corrosion and erosion caused by the corrosive agents in and the turbulence of the materials being processed; (6) cyclic stresses or corrosion fatigue. Discussion of all of these factors consists of valuable practical experiences of various refineries. VVK (13)

Progress in Cavitation Research at Princeton University. L. F. Moody & A. E. Sorenson. *Transactions American Society of Mechanical Engineers,* Vol. 57, Oct. 1935, pages 425-428. Test apparatus and an experimental method are described to determine the cavitation limit, at which cavitation begins, and not to ascertain consequences of maintained cavitation. In general, it was found that the results are entirely consistent with the cavitation principle as now generally applied. Ha (13)

Potential of Iron in Deaerated Solution (Sur le Potentiel du Fer en Solution Désaérée). F. Meunier & O.-L. Bihet. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 444-447. It has been shown that Fe becomes active in deaerated solutions by bubbling of pure N or H. That principle was used in measuring the potential in a vacuum or in air. The OH ion in the vacuum no longer has a passivating action. In an alkaline solution not only Fe but Ni, stainless Cr-Ni steels, and polished Pt act more or less as H electrodes. In acid solution on the contrary, the law varies and produces a state of dynamic equilibrium. Anions other than OH play important roles, according to their nature, and conc. CrO_4, e.g., creates a passive state even in a deaerated solution, while SO_4 reacts feebly. The theory of the phenomenon is discussed. MAB (13)

The Effect of Gases on Ferrous Materials at High Temperatures and High Pressures. Harold L. Maxwell. *Pennsylvania State College,* Mineral Industries Experiment Station, Bulletin No. 18, 1935, pages 128-136. H_2 at 100-250 atmospheres and 300°-400° C. causes embrittlement of metal due to grain boundary attack. There is a decrease in elongation and reduction of area with a moderate lowering in tensile strength. In NH_3 synthesis, equipment is exposed to temperatures of 500°-550° C. under gas pressures up to 1000 atmospheres; the gas is 75% H_2 and 25% N_2. The majority of metals suffer rapid deterioration. Addition of 2¼-3% Cr, with or without V, to plain C steel, diminishes H_2 attack. AHE (13)

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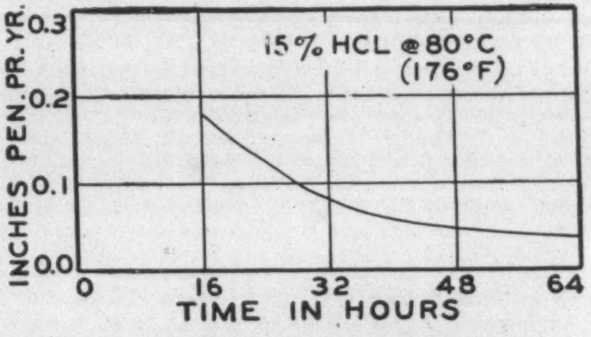

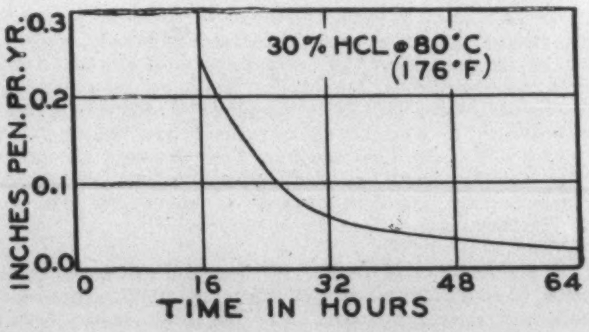

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Bimetal: Vedal (Bimetal: Le Vedal). M. Pubellier. *Metaux,* Vol. 9, Oct. 1934, pages 535-536. Vedal metal is duralumin covered with an Al layer. The Al layer is applied during manufacturing and rolling in. This metal retains the characteristics of duralumin. The principle underlying this development is the prevention of electrolysis between 2 elements, which may cause corrosion to set in. Duralumin, in a salt solution, is not attacked when in the presence of metals which are more electronegative such as 25% Ni steel, Al, C steel, Zn and Mg. On the contrary it is attacked when in the presence of more electropositive metals such as Pb, Sn, Cu, Ni, etc. In order to illustrate the position of metals in the electrochemical series the following table gives the emf of cell 1% salt solution, with calomel electrode: Pt +0.347; Au +0.218; Ag +0.006; Ni —0.08; Cu —0.223; Si —0.315; Bronze —0.418; Sn —0.422; Pb —0.483; duralumin —0.577; 25% Ni Steel —0.5; Al —0.707; Cd —0.744; 0.85 C steel —0.744; electrolytic iron —0.755; white metal (75% Sn and 25% Zn) —1.012; Zn —1.037; Mn —1.12; Mg —1.598. GTM (13)

Study of Corrosion of Thin Test Specimens (Étude de la Corrosion sur Éprouvettes Minces). Prot & Goldowski. *Chimie et Industrie,* Vol. 31, Spec. No. Apr. 1934, pages 555-556. Includes discussion. The methods used to date to characterize the susceptibility of a metal or alloy to corrosion (e.g., loss in weight, loss in mechanical properties, electromotive forces, etc.) are not suitable to reveal in a satisfactory manner the grave danger by pitting of the parts used in construction of floats or reservoirs in aeronautical materials. Corrosion of this kind can be determined in 0.1 mm. specimens in a very short time (a few days for duralumin). The technique used in preparing the materials and the results obtained are given in detail. MAB (13)

Some Conditions which Resist the Attack of Hydrochloric Acid on Alloys of Iron-Nickel-Tungsten or -Molybdenum (Quelques Conditions de Résistance à l'Attaque par l'Acide Chlorhydrique d'Alliages Fer-Nickel-Tungstène ou Molybdène). A. Portevin, E. Pretet & H. Jolivet. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 464-471. Study of the resistance of Fe-Ni-W (or Mo) alloys with 20-40% Ni and 10-25% W or Mo is made. Stainless alloys showed a considerably higher resistance. Corrosion decreased with increase in W, especially in concentrated media. Corrosion increased rapidly when the temperature was raised and decreased when Ni was increased. Corrosion was decidedly affected by the presence of impurities, especially C, even in minute quantities. The best results (in mechanical properties, forgeability, corrosion resistance, etc.) were obtained with alloys in a saturated austenitic state. Heating at high temperatures produced a homogeneity and put into solution the constituents high in W or Mo which separated out on cooling. MAB (13)

Industrial Alloys Resistant to Potassium Salts (Recherches sur les Alliages Résistants pour l'Industire des Sels de Potasse). V. Perchké. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 531-535. The behavior of various alloys containing Cu, Al, Ni, Fe, and Zn from the point of view of corrosion in carnallite and sylvanite solutions containing K salts was studied. MAB (13)

The Influence of Certain Organic Hydroxy-Compounds and the Corrosion of Iron in Oxygenated Salt Solutions. W. Stewart Patterson & R. C. A. Culbert. *Journal Society Chemical Industry,* Vol. 54, Oct. 4, 1935, pages 327T-331T. Describes a series of laboratory investigations on the corrosion of Fe in oxygenated 0.01 N-K_2SO_4, using 0.15 C steel with and without inhibitors. The conclusions from the investigations are: (1) Action of K_2SO_4 on Fe (high concentration of O) produces $Fe(OH)_3$ plus a thin invisible film of Fe_3O_4 which adheres to the metal, producing differential aeration. (2) The deposit adhering to the metal at low O concentrations is reduced to $Fe_3O_4.4H_2O$. (3) The corrosion rate at low O concentrations is directly proportional to O content, while it becomes constant and independent of further O additions at the higher O concentrations. The organic inhibitors $CH_2OH.CH_2OH$, $CH_2OH.CHOH.CH_2OH$, $(CH_2OH.CHOH)_2$, $CH_2OH(CHOH)_4CH_2OH$ and $CH_2OH(HCOH)_4CH_2OH$ retard corrosion by adsorption on the corrosion products, and by modifying the protective film structure. 6 references. AAA (13)

Developments in Steam Turbines. III. C. Richard Soderberg. *Mechanical World & Engineering Record,* Vol. 48, July 5, 1935, pages 7-9. In this instalment of a series of articles, scaling and blade failure are dealt with. The former is influenced notably by temperature and the latter is peculiarly a vibration effect. Up to the present it has not been found universally practicable to eliminate scaling by improvement of the evaporation process. One particularly difficult aspect is the corrosion of the blading and other parts which is inevitable if a heavily scaled turbine is idle a considerable part of the time. A satisfactory solution is to circulate heated air through the turbine in order to keep the deposits dry. The otherwise excellent 12% Cr type of stainless steel is not impervious to the effects of NaCl present in the deposits. An electromagnetic vibration tester has been designed in which structures can be tested to destruction at frequencies as high as 20,000 cycles/sec. WH (13)

Influence of the Addition of Special Elements on the Corrosion Resistance of 18-8 Austenitic Steel (Influenza dell'aggiunta di elementi speciali sulla resistenza alla corrosione dell'acciaio austenitico del tipo 18% cromo, 8% nichel). I. Musatti & A. Reggiori. *La Metallurgia Italiana,* Vol. 27, Sept. 1935, pages 629-650. Effect of additions of Cu, W, Mo, V and Ti to 18-8 austenitic stainless steel, with and without subsequent heat-treatment, on the resistance to corrosion by acids has been investigated. Additions were made as follows: Mo 1.5%; Cu 0.5 and 1.2%; W 2.2 and 5%; Ti 1%; V 1%; Cu 2.5- Mo 1%; Mo 3.25- V 1%; Mo 2.5- Ti 0.6%. For heat-treatment, hardening at 1050° C., and annealing at 550°-850° C. (the region of carbide formation) were both used. Addition of the above metals did not affect the intercrystalline corrosion of hardened 18-8, and only Ti improved the resistance of the annealed steel. All the specimens, when hardened after heating to 1050° C., resist corrosion by cold, concentrated as well as dilute (25%) HNO_3 and H_2SO_4. The resistance to dilute H_2SO_4 is improved by additions of Cu, Mo and Ti; resistance to HCl (5%) is improved by addition of Cu alone or by Cu-Mo. Annealing destroys the resistance to corrosion of all the above alloys except to concentrated and dilute HNO_3, and to concentrated H_2SO_4. However, addition of Cu, Cu-Mo, and Mo-Ti improves the resistance to 5% HCl markedly, even after annealing. Welding destroys all resistance to intercrystalline corrosion unless the alloy is subsequently heat-treated, except the alloy containing Ti, and to a certain extent that containing V. AWC (13)

Repair and Maintenance of Shells and Metallic Floats in Airplanes (Réparation et Entretien des Coques et Flotteurs Métalliques d'Hydravions). R. Lecoeuvre. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 547-554. Methods to control corrosion in structures are reviewed, as well as the means to maintain and repair metallic shells of light alloys and stainless steels. Research on protective coatings on light alloys is discussed. MAB (13)

Corrosion Resistance Tests of Metals Used in Pea Processing. F. L. LaQue. *Canning Age,* Vol. 16, Sept. 1935, pages 385-387, 406. Specimens of pure Sn, Ni, Cu, Zn, Monel, 50-50 soft solder, brass, 2 & 1 bronze and 18% Ni silver were suspended from standard holders at different points where pea handling equipment was exposed to corrosive conditions. In various cold brine separators and in contact with peas in hoppers and in storage, Sn and Ni were equally unaffected, with solder also showing very slight weight loss. Under severe corrosion conditions in the hot salt-sugar brine used to fill the cans, Monel metal and Ni were outstanding in their corrosion resistance with Sn but slightly attacked. Ni silver, bronze and Monel were least affected by conditions in the hot blanching tanks. Zn and Cu were in general most corroded of the metals tested. Tests were made by inoculating cans of peas with various concentrations of Cr, Cu, Fe, Ni, Sn and Zn, and inspecting them after several months storage. These showed Cu to darken peas when present in only 2 p.p.m. but above 50 p.p.m. it caused a much greener color than normal. Fe at 50 p.p.m. caused slight darkening but the other metals had no effect on the color. None of the metals affected the taste. BWG (13)

Progress Report on Cavitation Research at Massachusetts Institute of Technology. J. C. Hunsaker. *Transactions American Society of Mechanical Engineers,* Vol. 57, Oct. 1935, pages 423-424. Investigations on hydraulic cavitation were continued and some results are described regarding the relation between frequency of vapor collapse and the variables accountable for it. A new method for testing resistance to cavitation is described. In general, previous results were confirmed. Ha (13)

Influence of Coldwork on the Intergranular Corrosion of 18-8 Rustless Steels (Etude de l'influence de l'ecrouissage sur la corrosion intergranulaire des aciers inoxydables 18-8). Van den Bosch & Viale. *Métaux,* Vol. 10, Mar. 1935, pages 66-75. Discusses intergranular changes which take place in reheating annealed 18-8 Cr-Ni steels. Takes up changes on reheating the cold-worked material, the mode of precipitation of the carbides, the rate of heating which gives rise to changes, and the influence of cold work on the temperature range of susceptibility to alteration. Deals with the stabilization of the steel, starting with cold-worked metal, and its application to welding. Regarding the use of stabilized 18-8 steel the following conclusions are drawn: (1) This material can be arc welded without alteration, (2) when used hot, in contact with reagents capable of setting up intergranular corrosion at temperatures below the temperature of stabilization, if this stabilization is not complete, the first hours at the temperature may cause a precipitation of carbide in the grain boundaries; this precipitation is, however, much less than in annealed 18-8 steel, and consequently homogenization is more rapid. It is sufficient that the intergranular corrosion due to the reagent shall proceed more slowly than the re-homogenization. GTM (13)

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Rusting and Scaling of Structural Steels Under Tension (Rosten und Zundern von Baustählen unter Zugbeanspruchung). E. W. Müller & H. Buchholtz. *Archiv für das Eisenhüttenwesen,* Vol. 9, July 1935, pages 41-45. A series of low-C structural steels and a 0.2% C, 0.6% Cu, and 0.4% Cr steel were subjected to 9 months of atmospheric corrosion while under tensional stress close to the yield point and also after 5% deformation. The loss in weight was very little affected by the stress or deformation, although the unstressed specimens showed a slightly greater loss in weight; this was explained on the ground that the rust showed less tendency to flake and thus retained moisture. On the other hand on immersion in water the unstressed specimens showed slightly less corrosion. In another series of tests the degree of scaling at 600°-950° C. of stressed and unstressed specimens was determined. The steels were a low-C steel, a 0.13% C, 0.4% Mo steel, and a 0.17% C, 0.96% Cr, 0.5% Mo steel. When the tensional stresses were not high enough to cause noticeable deformation there was no change in the degree of scaling. But when the stresses produced appreciable flow and cracking as in the brittle temperature range at 600° C., the rate of scaling was, of course, increased. SE (13)

Corrosion of Ternary Alloys of Magnesium. Susumu Morioka. *Kinzoku no Kenkyu,* Vol. 12, July 1935, pages 322-356. In Japanese. On the basis of the results of the former report the corrodibility of ternary alloys of Mg with 6 elements such as Zn Cd, Sn, Pb, Al and Sb was studied. 15 series of ternary alloys were made by systematically adding 2 of these elements to Mg in quantities from 1 to 8%, except for Sb (0.3-3%), and their corrodibility was studied in the cast state. The results obtained show that the ternary alloys of the system, Mg-Zn-Sn, Mg-Zn-Cd, Mg-Sn-Cd, Mg-Sn-Pb, Mg-Zn-Sb and Mg-Sn-Sb have comparatively great resistance to corrosion, especially in the range of Zn 1 ~ 3%, Sn 2 ~ 8%; Zn 3 ~ 6%, Cd 1 ~ 6% (Zn + Cd<10%); Sn>3%, Cd 1 ~ 3%; Sn 4%, Pb 1 ~ 6%; Sn 1 ~ 6%, Sb 0.3 ~ 0.6% and Sn 2 ~ 3%, Sb<0.8%, respectively. The effect of added metal varies considerably with the kind or amount of the second element. KT (13)

Corrosion Tests on Duralplat at Norderney (Korrosionversuche mit Duralplat in Norderney). W. Stenzel. *Metallwirtschaft,* Vol. 14, Aug. 30, 1935, pages 696-699. The results of corrosion tests on duralumin clad on both sides, 5% and 10% of the total thickness, with duralumin K, an Al-Mg-Si alloy, and with a 1% Cu-Al alloy are given. Some of the samples were in the North Sea continuously, others were immersed during high tide and exposed to air during low tide. The tests ran for 4 years and periodically physical properties and weight loss were determined. Duralumin which is not clad lost weight and strength rapidly under these conditions, due to the pitting effect of the salt water. The .5 mm. thick sheets clad with 5% duralumin K began to lose strength after about 15 months, but the heavier sheets did not lose strength over the full test period and their weight losses were slight. The weight losses of the thin sheets were greater than those of the heavy sheets. Even the .5 mm. sheets clad with 5% duralumin K had much longer life than unprotected duralumin. By increasing the thickness of the coating to 10% on both sides the life of the thin sheets was extended to 4 years without loss of strength, but at expense of a corresponding reduction in initial strength. Similar results were obtained with duralumin clad with a 1% Cu-Al alloy, but the weight losses were greater than with the Cu free coating. The 1 mm. thick samples were still free from pits after 3 years exposure. The advantage of the 1% Cu coating is in its greater strength. By its use the strength of the core material was reduced 2.5%, while duralumin K reduced it 5%. CEM (13)

Corrosion Resistance of Strong Wrought Light Alloys (Korrosionbeständigkeit hochfester Leichtmetall-Knetlegierungen). Erich K. O. Schmidt. *Metallwirtschaft,* Vol. 14, Aug. 30, 1935, pages 699-701. Duralumin and similar alloys have good resistance to ordinary atmospheric corrosion. In thin sheets the loss in strength amounts to about 10% after 2¼ years. Sea water and salt atmosphere attack them quickly. Al alloy parts should be so designed and constructed that no pockets or recesses are formed where moisture can accumulate. Some early corrosion failures have been traced to faulty heat treatment. The resistance to corrosion can be increased by anodic oxidation, by plating with Zn or Cd, and by the use of Al clad duralumin or 9% Mg-Al alloy. CEM (13)

Split-Cavitation in High-Speed Water Turbines (Spaltkavitation an schnelllaufenden Turbomaschinen). Hans Mueller. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Sept. 28, 1935, pages 1165-1169. The mechanical conditions which lead to cavitation on the propellers of turbines are discussed. Means for reducing this formation to a minimum are either a coating of the front side with a wear-resisting material, or making mechanical arrangements whereby eddies are not formed against the metallic surface. Ha (13)

Corrosion Resistant Steels in Petroleum, Chemical and Allied Industries. H. Leroy Whitney. *Welding Journal,* N. Y., Vol. 14, Aug. 1935, pages 23-24. See "Alloys that Resist Severe Corrosive Conditions," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 419L/4. WB (13)

Boiler Steel Embrittlement. Everett P. Partridge. *World Power,* Vol. 24, July 1935, pages 42-45. Reprinted from *Mechanical Engineering,* May 1935. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 339L/1. WB (13)

Metallizing in Industry. J. W. Hishon. *Metallizer,* Vol. 3, July 10, 1935, pages 2-5, 11. A large number of applications of metal spraying throughout the world are discussed. In the field of corrosion prevention alone it is estimated that the market for metallizing in the U. S. and Canada is $500,000,000 per year with the saving to industry of 4 times this amount. The use of Zn sprayed coatings to protect bridges, canal lock gates, signal lamps, anchor plates, water tanks, traffic posts, and even heavy artillery near the coast, is quite well established. Rail ends are sprayed with Zn in Italy, with Al in England. Nails are being coated with Zn or Al by spraying in rotating drums at a rate of 50 lbs. in 8 minutes. Concrete tanks have been successfully Pb coated by metallizing. BWG (13)

Cavitation Testing of Model Hydraulic Turbines and Its Bearing on Design and Operation. L. M. Davis. *Transactions American Society of Mechanical Engineers,* Vol. 57, Nov. 1935, pages 455-462. The work done in this field is reviewed and results correlated. The question is an entirely mechanical one, depending mainly on the vapor pressure of the water existing when hitting the blade. The establishment of conditions where least or no cavitation occurs is discussed. Ha (13)

A Quick Method for Testing Corrosion Resistance of Aluminum and Aluminum Alloys (Über eine Schnell-Methode zur Prüfung der Korrosionsbeständigkeit von Aluminium und Aluminium-Legierungen). H. Carlsohn & W. Voigt. *Chemische Fabrik,* Vol. 8, Apr. 3, 1935, pages 126-127. Two solutions can be used, both of which depend on a color-reaction to indicate whether or not the Al will corrode. As an example an oxide is produced on a piece of Al by dipping in a hot K_2CrO_4, Na_2CO_3 solution and scratches are cut through the oxide coating with a diamond. A filter paper is dipped in the first reagent, a solution containing .5 cc. of .4% alcoholic morin and 3 g. NaCl in 100 cc., and pressed against the sample. It is then observed through an analytical quartz lamp and where the scratches are a strong green fluorescence appears. The other solution consists of .1% alizarin—$NaHSO_4$ and 3% NaCl. A filter paper is dipped in the solution, pressed against the sample, removed and placed in dilute acetic acid. The paper turns red on areas corresponding to corrosion on the Al. CEM (13)

Corrosion of Air-conditioning Ducts. Ralph W. Baker. *Sheet Metal Worker,* Vol. 26, Nov. 1935, pages 514-516. Causes and avoidance of corrosion of equipment for air-conditioning are discussed. Water vapor or moisture completely held in mechanical suspension and not deposited on metallic sheets do not affect the life of sheets, the moisture must first deposit to become active. Deposition of moisture is caused by temperature changes, temperature differences between air current and sheets, or by dust particles. Galvanized ferrous sheets afford the greatest resistance to moisture attack. Ha (13)

Deposits in White Metal Carburetors. E. L. Baldeschwieler, G. M. Maverick & J. E. Neudeck. *S. A. E. Journal,* Vol. 37, Oct. 1935, pages 17-21. Corrosion of white metal die cast carburetors is reported as due to presence of water in fuel system from condensation of atmospheric moisture, etc. Corrosion products mostly ZnO deposit in the carburetor, are carried into fuel line, and cause stoppage of motor. Corrosion tests on die cast metal (composition not stated) are reported and shown in photos for various gasolines, distilled, tap and sea water, both alone and as a two phase system of gasoline-water. The effect of electrolytic action is considered to have been tested by placing a brass chain in contact with the samples. Another series of tests of the two phase system was made using a vacuum for "practical" removal of O_2 and introducing N_2 in order to test the effect of "absence" of O_2 on this type of corrosion. Conclusion is that either leaded or non-leaded gasoline alone is not responsible for or contributory to corrosion, the corrosion is due to action of water on the metal, O_2 is not necessary for progress of corrosion, but presence of O_2 and salts accelerate corrosion. Electrolytic action (from copper pipe lines to carburetor) as tested by the brass chain, is considered to be slight. Gasoline is considered to protect the metal by preventing access of O_2 to the condensed moisture in the carburetor. WB (13)

Action of Town Gas Combustion Products on Metals. First Report of the Research Executive Committee of the Institution of Gas Engineers (London). *Iron & Coal Trades Review,* Vol. 131, Nov. 8, 1935, page 765. Experiments are described in which a number of metal tubes have been simultaneously subjected to the continuous action of products of combustion using gas with a S content of 8 g./100 ft.^{3} Pb, Sn and solder showed a marked superiority over other metals, but the difference becomes less pronounced with decreasing S content. The rate of corrosion falls as the S content of the gas is reduced, but even if S is completely removed corrosion will still occur. The HNO_3 content of the condensates of combustion becomes relatively more important as the S content is reduced, and would account for corrosion in S-free gas. Ha (13)

The Corrosion of Tin and Aluminum. *Tin,* Sept. 1935, pages 4-6. A review is given of parts of the 1934 report of the Food Investigation Board (British). Results with plain and once-lacquered Al cans used for fruits were unsatisfactory because of rapid formation of hydrogen swells. Al is successfully used in canning fish but is considered to be even more dependent than Sn plate on the protection by lacquer of surfaces exposed to acid products such as fruits. NaCl was found to have a slight inhibiting action on the corrosion of Sn by citric acid; sugar, especially beet sugar, definitely retarded corrosion by citric acid. NaCl stimulated corrosion of Al by citric acid but sucrose acted as an inhibitor. At high acidity Sn was attacked more severely than Al. BWG (13)

Electric Conductivity of Rust (Die Elektrische Leitfähigkeit des Rostes). Günther Cohn. *Zeitschrift für Elektrochemie,* Vol. 41, Sept. 1935, pages 660-664. For the local element current theory of corrosion the conductivity of rust must be appreciable and such determinations are thus valuable. The conductivity of rust (1) formed at 50° C. for 21 years on the inside of a cast iron condenser tube, (2) formed for many years on a garden bench near the sea coast, (3) formed for 206 years on a cast iron cannon submerged in sea water, and (4) formed on an old Viking wrought iron sword in a dry place for 1000 years. The composition of the rust in % of Fe_2O_3, FeO, H_2O, total C and free C was, respectively, for (1) 20.6, 41.4, 10.6, 7.9, 5.8; for (2) 50.3, 37.1, 9.2, 2.9, 1.5; for (3) 41.3, 23.1, 13.4, 8.8, 6.1; and for (4) 77.1, 7.2, 12.5, 1.2, 0.0. The total C and free C in the original iron in % was, respectively, for (1) 3.0, 2.8; for (2) 2.9, 1.5; for (3) ?, ?; and for (4) 0.25, 0.0. The specific conductivity for these samples of rust were, 19.7, 0.3, 28.0 and 0.8 reciprocal ohm. cm. The rust consisted of mixtures of α-FeO(OH) and Fe_3O_4 with graphite and carbide except for (3) where the crystal size was so small that separate X-ray diffraction lines could not be distinguished, except for graphite. These conductivity values are high due to networks of graphite and carbide in the rust. These highly conducting networks are responsible, through their conductivity, for the corrosion accelerating power of rust. The depolarizing action is effective through this action of the graphite and carbide. The action of the C in the rust is similar to the action of graphite originally mixed with the Ni oxide used in the alkaline or Leclanche cell. The electrical conductivity of two types of Acheson graphite with 0.44 and 0.08% ash and porosities of 29.8 and 31.4%, respectively, was determined at 20° C. as 966 and 1420 reciprocal ohm cm. HAS (13)

Oxidation and Scaling of Ferrous Metals. S. A. Main. *Iron & Coal Trades Review,* Vol. 131, Oct. 18, 1935, pages 634-635; Oct. 25, 1935, page 685. The effects of scaling due to high temperatures in the manufacturing process cause losses not only in the manufacturing process itself, amounting to something like 2-3%, but also later in using the finished product as the scale has to be removed for further processes (painting, plating). The efforts made to prevent or reduce greatly the scaling by alloying with other non-ferrous metals, especially Cr and Ni, and the possibilities of finding some new alloying metal or some other way are discussed but found not to be very bright. Ha (13)

14. APPLICATION OF METALS AND ALLOYS

Seamless Metallic Spring Parts (Nahtlose metallische Federkörper). K. Armleder. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Sept. 28, 1935, pages 1175-1176. The manufacture of corrugated pipes, membranes, diaphragms, is described briefly. Metals used are a specially tough, non-corroding tombac alloy, German silver, Ag, sometimes Fe. They can be Sn-, Ni-, Ag-, Cr- and Pb-coated. They are used as thermostats, parts of regulators, packing material, etc. Ha (14)

Surface Hardening for Bearing Purposes. C. H. Bierbaum. *Machinery,* N. Y., Vol. 42, Nov. 1935, pages 204-205. The advantages of hardening bearing surfaces by Cr plating or nitriding and conditions which make application of the methods advisable are discussed and a few cases described. Ha (14)

The Piping Installation. A. V. Knowles. *Motor Boat,* Vol. 63, Aug. 1935, page 125. Cu is generally used for all water, fuel, and oil pipes in the circulating system of a motor boat, and flanges and unions on Cu pipes are generally of brass and should be brazed or hard (silver) soldered. For dry exhaust either wrought Fe pipes with flanged fittings, or steel pipes with welded flanges are most suitable. JWD (14)

Materials Recommended for Oil Refinery Pumps. A. E. Harnsberger. *Chemical & Metallurgical Engineering,* Vol. 42, Mar. 1935, pages 144-145. **Specifies Steels, Alloys and Metals for Parts of Oil Refinery Pumps.** *Steel,* Vol. 96, Mar. 4, 1935, pages 64-66. From paper read before the A.I.M.M.E., Feb. 20, 1935. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 464L/1. MS + PRK (14)

The Role of Metals in the Railway Industry. E. J. W. Ragsdale. *Iron Age,* Vol. 135, June 27, 1935, pages 18-20, 80, 82. From a paper read before the American Society for Metals in New York, May 24, 1935. Discusses problems involved in the use of new materials and the possibilities such applications offer for the future. VSP (14)

■ 14a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Metallizing in the Northwest. John Storkerson. *Metallizer,* Vol. 3, July 10, 1935, pages 6-7. Metal spraying in the Portland, Oregon, district has consisted largely of repairing and rebuilding worn machinery and coating materials for greater corrosion resistance. Coating wooden highway bridge railing spindles with Pb and Cu, coating tractor and Diesel engine heads with Al in the explosion chamber and Cu on the outside for cooler operation, and coating aeroplane exhaust pipes with Al are examples of unusual satisfactory applications. BWG (14a)

Copper in Needlework and Textiles (Le Cuivre dans la Tapisserie, la Broderie, la Passementrie et les Tissues divers). V. Cheilly. *Cuivre et Laiton,* Vol. 8, Sept. 15, 1935, pages 381-383. The art of making gold threads and their ancient and modern use in tissues, ornaments and needlework of all kinds is described. Ha (14a)

Copper as Printing Metal (Le Cuivre, Metal d'Impression). A. Chaplet. *Cuivre et Laiton,* Vol. 8, Oct. 15, 1935, pages 428-430. Preparation of Cu plates for different printing processes is described. Ha (14a)

Dome Recovered with Hard Lead. *Sheet Metal Worker,* Vol. 26, Sept. 1935, pages 406-408. A Pb-Sb alloy containing 7.5% Sb was used; procedure described and illustrated. Ha (14a)

Free Cutting Aluminum Alloys for Screw Machine Work Now Available. *Iron Age,* Vol. 136, July 25, 1935, pages 27-29. Al, because of the development of certain alloys, has been added to list of free cutting metals. At least 2 alloys, one with Mg and one without, in two tempers, are available. Deals with procedure followed in developing the alloys by the Aluminum Co. of America. VSP (14a)

Copper Pipes in Hot Water Installations (Le Tube de Cuivre dans les Canalisations d'Eau chaude). *Cuivre et Laiton,* Vol. 8, Sept. 15, 1935, pages 379-380. Advantages of Cu over Pb and galvanized Fe are enumerated. Of particular importance is the stored heat energy which is smallest in Cu, largest in Fe for a given installation of the same capacity. Ha (14a)

Use of Light Metals in the Bodies of Motor Vehicles (Die Anwendung von Leichtmetallen in Kraftwagenaufbauten). *Automobiltechnische Zeitschrift,* Vol. 38, Sept. 25, 1935, pages 461-466. The many uses of Al and Al alloys in delivery trucks, specially shaped trucks for special purposes, milk tanks, trailers, etc. are discussed and many examples from several countries described. Al foil is used as heat insulation for refrigerator cars. Ha (14a)

Aluminum Wool as Packing Material for Caulking of Socket Joints (Aluminumwolle als Dichtungsmittel zum Verstemmen von Muffendichtungen). *Aluminium,* Vol. 17, Sept. 1935, pages 492-493. Al wool is made of purest Al by a special process and is very plastic and flexible; it can replace Pb wool and has the further advantage that it has a very great adhesive capacity. 1000 kg. Al wool does the same packing as 7000 kg. Pb; it is therefore very economical from the German viewpoint as Pb has to be imported while Al is a domestic material. A table gives the weight of Pb and Al wool used for one packing and the height of the packing groove for different pipe diameters up to 1200 mm. Ha (14a)

Aluminum as a Material for Building Construction. Francis C. Frary. *Industrial & Engineering Chemistry,* Vol. 27, Oct. 1935, pages 1128-1130. Versatility of Al as an architectural metal is presented briefly. MEH (14a)

Lead in Building and Construction. G. O. Hiers & C. H. Rose. *Industrial & Engineering Chemistry,* Vol. 27, Oct. 1935, pages 1133-1135. Brief review of the uses of Pb and Pb compounds in the building industry. MEH (14a)

Use of Aluminum in Electrical Installations (Aluminiumverwendung in der Elektrotechnik). F. Remde. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Sept. 21, 1935, pages 1148-1149. Use of Al and Al alloys to replace Cu in electrical installations, methods of joining cables and bars by welding, and profiles used for bus bars are reviewed. Ha (14a)

Enter the Copper House. *Iron Age,* Vol. 136, Aug. 29, 1935, page 25. Describes a Cu house constructed by Copper House, Inc. Outside walls, roof and roofing accessories are of Cu. Framework as well as the floor joists are of structural steel. Roof is covered with 16 oz. sheet Cu over wood deck. Heat and cold insulation is provided for by a 4″ thickness of spun glass. Prices range from about $4,500 upward. VSP (14a)

Cadmium-base Bearing Metals. Alan S. Gill. *Metal Industry,* London, Vol. 46, June 14, 1935, pages 650-652. Abridged version of a paper before the Australasian Institute of Mining & Metallurgy. See *Metals & Alloys,* Vol. 6, Mar. 1935, page MA 126L/10. HBG (14a)

Tin in Bearing Metals. *Tin,* Aug. 1935, pages 8-9. A general review is given on late developments in bearing metals with particular attention paid to results of a study by F. K. von Göler and G. Sachs (*Metallgesellschaft,* May 1935). Bearing metals of 80-93 Sn, 3-12 Sb and 3-10 Cu are considered to have the best all-round properties for the majority of purposes. They are especially characterized by good running properties at high velocities and temperatures. The addition of a small percentage of Cd increases the fatigue strength by 20%, appreciably improves the tensile strength up to 180° C., and favorably aids the running properties. Addition of Ni has not yet proven definitely beneficial. Too high a percentage of Cu and Sb makes the bearing metal brittle and sensitive to shock. Addition of Pb with Cd is permissible only if the maximum running temperature remains below 150° C. By reducing the Sn base bearing lining to 0.5 mm. the life may be prolonged considerably and such bearings meet requirements of Diesel and aero engines if complete adherence between lining and backing is secured. Pb base alloys may be used for moderate stress but they have not proven equal to high performance. Cd base bearings will stand much greater stress than Sn base metal but it is difficult to produce good lined bearings. Zinc base bearings have small load-bearing capacity and a tendency to attack the shaft. An Al-Si alloy (K.280) that has been used for automobile engine connecting rods without any bearing lining is being successfully tried out as a bearing metal. BWG (14a)

Photographs on Aluminum (Seo-Photo Process) (Das Lichtbild auf Aluminium (Seo-Foto-Verfahren)). Alexander Jenny & Nikolai Budiloff. *Chemische Fabrik,* Vol. 8, Sept. 18, 1935, pages 359-363. The anodic oxidation of Al is briefly described. The oxide formed on the surface contains netlike colloidal porous passages capable of absorbing liquids. Anodized Al can absorb light sensitive materials without the use of gelatine or other emulsions. Soluble materials are absorbed in the form of solutions and the solvent is dried out. Insoluble materials are formed in the surface film by absorbing one soluble reagent and letting it react with another soluble reagent in the pores. These light sensitive Al plates are then exposed and developed in the usual manner. Their advantage over paper lies in their hardness, strength, corrosion resistance, insolubility in organic reagents and fire resistance. On heating the color changes. Beginning at 100° C. it turns from black to brown, at higher temperatures to red and to purple. Toning in solutions of salts produces various colors. Pure Al is the cheapest and best material to use, preferably in the hard rolled condition. A good surface free from defects is necessary. The Al should be at least 99.5% pure. The oxide film must be light colored and porous. In the anodizing process d.c. is used, with chromic or oxalic acid solutions. With oxalic acid a clear colorless film is obtained, with chromic acid a dull, almost white surface with good absorption. Best results are obtained by using a chromic acid bath first, then oxalic acid. This produces a harder surface than chromic acid alone. The Al can also be treated in oxalic acid after exposing and developing to protect the photograph. Details for impregnating the plates are given. They are usually dried by centrifuging. Exposing, developing and fixing are handled in the usual way. The prints are then toned in Au solutions. Hg solutions cannot be used. To protect against finger marks wax, oil or lacquer is applied, filling up the pores. The print can be intensified, forming a layer of metallic Ag, on which Cu, brass, Cd or Au is plated to obtain a relief. The unexposed areas remain white and can be colored with organic colors. Corrosion tests have been made to determine the life of the photographs. The process can also be used for signs, advertisements, instrument scales, maps, documents and novelties. CEM (14a)

The Use of Aluminum. L. E. Kunkler. *Metallizer,* Vol. 3, July 10, 1935, pages 8-11. Al is said to have a wider range of uses in the metal spraying field than any other metal, especially for use in coatings for prevention of corrosion. Factory tests and records of practical use show an Al coating of 0.010″ or over to be non-porous. The corrosion resistance of sheet Al to a large list of products, as compiled by the Aluminum Corp. of America, is given. BWG (14a)

Nickel-containing Bronzes in the Automobile Industry. L. Abbot. *American Metal Market,* Vol. 42, Aug. 9, 1935, page 6. An alloy of 88% Cu, 11.2% Sn, 0.3% P and 0.5% Ni is widely used for parts to stand heavy loads and abrasion, especially in worm gears for transmissions. Shock-resisting properties are improved by addition of small percentages of Ni, and the structure made more homogeneous, the grain finer. Ha (14a)

Rapid Progress in Copper Roofing (Les Progrès rapides des Traveaux de Couverture en Cuivre). H. Bréau. *Cuivre et Laiton,* Vol. 8, Sept. 15, 1935, pages 373-376. Methods of roofing, decorative and artistic effects, artificial patina and lead coated Cu are reviewed. Ha (14a)

Anode Materials for High Vacuum Tubes. E. E. Spitzer. *Electrical Engineering,* Vol. 54, Nov. 1935, pages 1246-1251. The requirements of anode material for power tubes are outlined; the higher the temperatures which the anode material can stand the better the tube is for transmitting purposes. Carborundum-blasted Mo has recently been evolved; Mo has better mechanical properties than W in this respect. C-coated Ni anodes also behave well. Cooling and general arrangement and manufacturing data are described. Ha (14a)

New Fields for Profits in New Metals. E. S. Shepard. *Sheet Metal Worker,* Vol. 26, Oct. 1935, pages 461-462, 464. Cr plated Cu and Cr plated Zn sheets are used in metal signs, decorative arrangements, posters, etc. Ha (14a)

Use of Cast Aluminum in Large Electric Arc Furnaces (Die Verwendung von Aluminiumguss bei grossen Lichtbogenöfen). A. von Zeerleder. *Aluminium,* Vol. 17, Oct. 1935, pages 529-530. The concentric mantles of non-magnetic material used as conductors in the Miguet furnace, usually made of cast bronze, were replaced with good success by cast Al plates of 2.5 m. height and 4.6 m. diam.; the composition was 1.4% Fe, 2% Cu, 12% Zn, 0.2% Mg, rest Al. The furnace carries up to 80,000 amps. and the mantles weigh 5300 kg. against 15,000 kg. for the bronze mantles. The Al mantle has been permanently in operation since 1930. Ha (14a)

Aluminum and Its Alloys—With Special Reference to Transportation. N. Warren Waterhouse. *Journal Institution of Engineers of Australia,* Vol. 7, Aug. 1935, pages 295-304. Methods for the production of Al and its alloys are outlined and their value indicated. Applications in aircraft, pleasure craft and railway and highway transportation are pointed out. WHB (14a)

Metallizing in Ice and Refrigerator Plants. V. A. Cook. *Metallizer,* Vol. 3, Aug. 15, 1935, pages 2-3. Sprayed Zn is extensively used in California ice plants for protection of refrigeration equipment against corrosion and for repair of galvanized parts. Coatings of from 0.006″ to 0.09″ thickness are recommended. BWG (14a)

Steel-Cored Aluminum. *Electrician,* Vol. 115, Oct. 11, 1935, pages 435-437. Economic advantages for long span lines of steel-cored Al conductors are pointed out. Use of anti-vibration dampers is shown to be of advantage. Design of clamps and connections is discussed. CBJ (14a)

America's First Copper House. *Sheet Metal Worker,* Vol. 26, Oct. 1935, pages 458-460. Constructive details are given of a house with roof and all outside walls covered with Cu sheets of 0.065″ thickness, the roof with 16 oz. Cu sheets. Walls are 6″ and insulated. The roof is insulated with 4″ of spun glass. The heat-transmission factor is 0.08 against 0.25-0.30 for brick. 40% of the total cost of the house went into Cu, brass or Cu alloys. Ha (14a)

Use of Copper in Organ Pipes (L'Emploi du Cuivre dans la Construction des Tuyaux d'Orgues). *Cuivre et Laiton,* Vol. 8, Oct. 30, 1935, pages 445-448. In the Middle Ages Cu was almost exclusively used in the construction of organ pipes but when the instruments became larger it was replaced by Pb and Sn. Cu has, however, been shown in accoustical tests to give the purest and fullest tone. Design and use of Cu in the different registers of an organ is described. Ha (14a)

Aluminum and Aluminum Alloys as Material in the Chemical Industry (Aluminium und Aluminiumlegierungen als Baustoff in der chemischen Industrie). Fritz Ohl. *Werkstoffe & Korrosion,* Vol. 10, Oct. 25, 1935, pages 45-47. Complete tables show the chemical substances for which Al and Al alloys are suitable, not suitable or only with certain limitations. In general, the alloys which can be employed in the chemical industry are aludur 533 (corrofestal), anticorrodal, AW 15, BS seawater, duranalium, heddal, hydronalium, KS seawater, legal, mangal, M 115, pantal, peraluman, silumin, ulmal. Unsuitable are aludur 630/580/570, alufont II, avional, bondur, German alloy, duralumin, heddur, igedur, KS special alloy, lautal, L IV, polital, ulminium, y-alloy. Ha (14a)

Thermocouples. W. Pratt. *Transactions North East Coast Institution of Engineers & Shipbuilders,* Vol. 51, 1934-35, pages 103-118. Mathematical discussion of thermoelectric effects, power and E-T curves for base and noble metal couples. Appendix gives calibration tables for various batches of thermocouple wire. The various methods for hooking up temperature measuring systems are discussed and given digrammatically in respect to economy in use of short thermocouple leads and minimum of cold junctions. WB (14a)

New Markets and Uses for Zinc. Russell B. Paul. *Mining Journal,* Vol. 191, Oct. 26, 1935, pages 807-808. Read before American Mining Congress, Sept. 23-27. Production of high purity Zn has led to Zn-rich alloys for die casting, these alloys possessing properties never before associated with Zn in any form. High purity metal is of increasing importance in galvanizing and brass manufacture. Zn pigments are greatly improved by new production methods, Zn-ZnO (for metal), ZnO, ZnS, lithopone (28% ZnS), and cryptones (50% ZnS), the latter a new line of mixtures. Uses of ZnO in rubber continue. AHE (14a)

■ 14b. Ferrous ■

M. GENSAMER, SECTION EDITOR

Brake Drums of Nickel Alloy Cast Iron (Bremmstrommeln aus Nickelgusseisen). E. Pohl. *Deutsche Motor Zeitschrift,* Vol. 12, July 20, 1935, page 130. Following material is said to be particularly resistant to wear: 3.2% total C, 2.25% Ni, 1.6% Si, 0.7% Mn, 0.4% Cr. Brinell hardness = 240; tensile strength = 32 kg./mm.² By means of a special melting procedure, a tensile strength of 35-50 kg./mm.² can be secured with the following alloy cast Fe: 2.8% total C, 2.0-2.5% Ni, 1.5-1.75% Si, 0.2-0.3% Cr. Some analyses include low additions of Mo. Martensitic Ni-cast Fe is especially suited for highly stressed brake drums. Before machining, the cast Fe is softened by a heat treatment. Ni-resist with 12-15% Ni, 2-4% Cr, 5-7% Cu has about the same thermal expansion coefficient as silumin and is utilized as a brake drum lining for light alloy brakes. WH (14b)

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Nickel-Alloy Gear Materials and their Heat Treatments. J. W. Sands & F. J. Walls. *Product Engineering,* Vol. 6, Oct. 1935, pages 370-373. Addition of Ni to cast Fe, steel or bronze has made the materials more resistant to the complex strains, stresses and shocks inherent in gear drives. Compositions, properties of and fields of application for direct hardening Ni alloy, case-hardening Ni alloy and carbon steels, and for cast steel and bronze alloy gears, and their heat treatment, are described and curves given. Ha (14b)

Pole Supports for Overhead Lines. L. F. Villiers. *Electrical Review,* Vol. 117, Aug. 23, 1935, page 240. Prefers steel for all classes of supports. Broad flange beams have been used successfully for telegraph and transmission poles, and also the portal and cantilever types for electric railway systems. MS (14b)

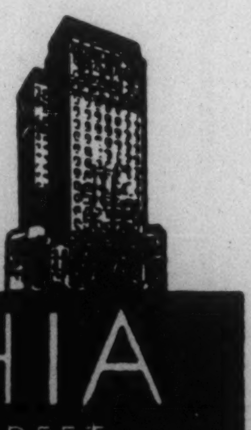
Stainless Steels. H. Bull. *Iron & Steel Industry,* Vol. 8, Mar. 1935, pages 241-245. Author considers the straight Cr steels for knives and the Ni-Cr steels for forks and spoons and hollow ware. The 2 types of steel are entirely different in physical properties and are used in 2 distinct conditions; knives are used fully hardened, Ni-Cr steels are generally used in their softest condition which is produced by quenching from high temperatures. Forging practice, annealing practice and corrosion difficulties in knives are discussed. The manufacture of spoons and forks from a low C steel with 12% each of Cr and Ni is briefly considered. CEJ (14b)

Steel Rails. Edward Fulton Law & Vernon Harbord. *Proceedings Institution of Civil Engineers,* Vol. 238, 1935, page 3. Consideration is given to the various types of steels suitable for the manufacture of rails, in view of the rapid wear which results from modern transport conditions. The use of Mn steel and Si steel is discussed and the effects of alloying elements, temperature control during manufacture, and of heat treatment are considered. A well-balanced combination of hardness and toughness is considered necessary for service, and it is suggested that these properties may be obtained by suitable addition of such elements as Cr and Mn, together with careful manufacture and treatment. JWD (14b)

Metal Office Chairs. John Parker. *Industrial Finishing,* Vol. 10, July 1934, pages 34, 38, 40. The chairs are welded into sub-assembly units and these units are cleaned, sprayed and baked before assembly. One-coat and two-coat bake finishes are used in solid colors or in imitation wood grain. JN (14b)

Advance of the Alloy Steels—Improved Physical and Chemical Properties Responsible for Extensive Use in Mining Field. B. H. Strom. *Engineering & Mining Journal,* Vol. 136, Sept. 1935, pages 450-454. The Hadfield high-Mn high-C steels are widely used in mining operations and many newer alloy steels have been used to advantage. A number of applications are illustrated. WHB (14b)

Opportunities for Steel. E. L. Shaner. *Steel,* Vol. 97, Oct. 28, 1935, pages 19-20, 78-81. Address delivered before the American Institute of Steel Construction. Emphasizes indispensability of steel in comparison with other basic materials. Outlines possibilities offered to the steel industry in modernization of transportation services and in rebuilding of cities. Discusses how to meet some of the problems of the steel construction industry. MS (14b)



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15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Colloid-electrochemical Laboratory and its Transformation into an Institute. V. A. Kistyakovskiy. *Vestnik akademii nauk SSSR,* Vol. 5, Feb. 1935, pages 7-14. In Russian. The Colloid-electrochemical Laboratory of the Academy of Sciences of the USSR is devoted to research in the following fields: 1. structure and electrization of disperse systems, 2. corrosion of metals, and 3. electrocrystallization of metals. Some of its achievements are enumerated. The great increase of the scope of research necessitated its reorganization and expansion to an Institute whose new aims are briefly outlined. ORS (15)

The Rare Earths. Alice V. Petar. *United States Bureau of Mines, Information Circular* No. 6847, July 1935, 46 pages. General discussion of the properties, occurrence, separation, uses, etc. AHE (15)

New Method for Extracting Gases from Metals (Sur une Nouvelle Méthode d'Extraction des Gaz dans les Métaux). Léon Moreau, Georges Chaudron & Albert Portevin. *Comptes Rendus,* Vol. 201, July 16, 1935, pages 212-214. Gases may be retained in metals by adsorption on the surface, by mechanical occlusions or chemically by solid solution. The new process for degassing consists in making the metal sample a cathode in a closed tube and, by the use of high voltage across the tube, degassing takes place through a mercury vapor pump and an oil pump placed in series with the closed system. The voltage may be high enough to heat the sample or the extraction may be carried out cold. Author shows the results of extracting CO_2, N_2, CO, H_2 from Al, Ca, Fe, Mg. Claims are also made to show the extraction of N_2 from Al both as nitrides and occluded gas. FHC (15)

Geo-Chemical Distribution Coefficient of the Elements (Die geochemische Verteilung der Elemente). Ida Noddack & Walter Noddack. *Svensk Kemisk Tidskrift,* Vol. 46, Aug. 1934, pages 173-201. In German. Based on analyses of meteors, conclusions are drawn regarding the absolute frequency of the occurrence of the elements. The interrelationship between frequency and atomic number is identical for meteors, stars and the sun. Fe, Ni and Mg which are relatively infrequent in the earth's crust, are probably more abundant at greater depths. With highly sensitive methods all elements will be found in all minerals. EF (15)

Handling Devices that Make Steel Mills Modern. *Blast Furnace & Steel Plant,* Vol. 23, Aug. 1935, pages 548-553. Includes descriptions of coke screening, weighing, and loading facilities at a blast furnace plant, by N. L. Davis; coil up-ender for strip; piling machine for cut sheets; fork-lift electric trucks for sheets; triple pot cinder car; conveyors for picklers; and sheet handling truck. MS (15)

The Cementation of Metallurgical Products and its Broad Application. Vol. II. Application of Cementation (La Cémentation des Produits Métallurgiques et sa Généralisation. Tome II. Généralisation de la Cémentation). Leon Guillet. Dunod, Paris, 1935. Paper, 6½ x 10 inches, 465 pages. Price 135 Fr.

Cementation, as used in this treatise, is defined as a process, the object of which is to produce a transformation in the surface, seldom complete, of a metallurgical product by the absorption of a new element, the metallurgical product remaining solid during the change. As is evident, the process applies to a far wider field than that designated by adding carbon to steel or iron.

Chap. I is introductory in character, giving principles, history, and controlling factors. Chaps. II and III of 20 and 30 pages are devoted to cementation of steel with zinc, sherardizing, and with aluminum, calorizing. Chap. IV of 150 pages gives a comprehensive treatment of nitriding. Chap. V of 28 pages presents cementation of ferrous materials with Mn, Si, Cr, W, Mo, V, U, Zr, etc., while Chap. VI of equal length is given to cementation of Cu and its alloys with Zn vapor, and with Al, cementation of Ni, Co, Al, Al alloys, etc.

Chap. VII to XI inclusive discuss various phases of malleable cast iron, including production, properties, heat treatment, and high-strength malleable. Prof. Guillet seems to have developed a happy balance of theory, technology, and practice. The text is well illustrated with over 400 figures, including many excellent photomicrographs. Extensive data are presented in tabulations and graphs. Throughout the text there are references to the original literature, some 300 authors being cited, although the author has evidently used much of his own material. The references seem to cover the whole literature, but it can be noted that some of the more recent (1933-1935) American publications have not been included. The alphabetical tables of figures, authors, and subjects serve as a convenience in using this volume for ready reference work.

This publication brings together in well arranged form the information that is widely scattered in the literature on subjects in which there is much interest at this time. Prof. Guillet's contribution should be welcomed by metallurgists, particularly those who are working in cementation. O. E. Harder (15)-B-

Metallurgy (an elementary text book). E. L. Rhead. Longmans, Green & Co., New York, 1935. Cloth, 5½ x 8½ inches, 374 pages. Price $4.00. The first edition was published in 1895. The present edition is slightly amplified and corrected over that published in 1924. The book is supposed to be an introduction to general metallurgy, to be read by the beginner.

The field covered is primarily that of the metallurgy of smelting. Other fields are very sketchily dealt with. So many subjects are crowded into such small compass and reference is made to so many obsolete processes that the student would get a very jumbled and inaccurate impression of many things, including a good many that, in the brief way they are expressed, are not so, and many that are not important. Much of the revision in this edition consists in adding foot notes to correct statements that were liable to misinterpretation.

From the historical viewpoint the book may have some value for its mention of by-gone processes, but as a modern text book the reviewer considers it wholly inadequate. It is far behind the times, the 1935 revision distinctly failing to bring it up to date. H. W. Gillett (15) -B-

Organic Reagents for Metals. Research Laboratory Staff of Hopkin & Williams. 2nd Edition. Published by the Company, London, 1934. Paper, 5½ x 8½ inches, 107 pages. Price 1s 3d.

Analytical chemists have long dreamed of a specific reagent for each element. Most chemists are acquainted with the use of dimethylglyoxime for the detection and determination of Ni, although many are unaware that Pd is also quantitatively precipitated. Many chemists are unfamiliar with the vast amount of research work that has been done in the past decade in search for specific organic reagents. The monograph presents the current status of 26 organic reagents including a bibliography for each. In fact, one of the most valuable features of the booklet is the up-to-date bibliography of 365 references.

The reader will learn that many of the organic reagents are still in the embryonic stage, others have been developed to the place where they can be used successfully for qualitative work, and others can be used quantitatively. The authors have used unusual care in pointing out the limitations of the reagents, and the interfering elements.

The book is recommended to analytical chemists and teachers. Students should be acquainted with organic reagents as an analytical tool, and the condensed compilation of methods and the excellent bibliography should prove an invaluable aid to them.

John D. Sullivan (15) -B-

Materials Handbook—Iron and Steel (Werkstoff-Handbuch Stahl und Eisen. 4. Serie Ergänzungsblätter) Verlag Stahleisen, Düsseldorf, 1935. 35 loose leaves, 2 folded tables, 6 x 8¼ inches. Price 5.25 RM.

The 1935 additions to this German loose leaf handbook comprise a revision of the section on plain carbon steels, and new sections on soldering of steel, temper brittleness, high tensile structural steel, heat resistant steels and alloys, steels for knives, heat treatment in metal and salt baths, quenching media, polishing, means for sorting out steels that have gotten mixed up, (spark testing etc.) laboratory arrangement, pickling, yield strength at high temperatures (rate of loading definitely regulated), creep testing (so called—referring only to the 25th to 35th hr. accelerated method of Pomp the results from which receive little credence outside Germany) and corrosion-fatigue.

The topics are but briefly treated, contain little of value not available in handbooks in English and the references are about 99 44/100% to German publications. Buzzard's spark test chart is given and credited to "an American source," without stating the source, though in this case the Buzzard reference is included in the bibliography. In the section on corrosion-fatigue the curves are taken from and credited to McAdam but none of McAdam's articles are included in the bibliography. These particular sections are perhaps of more interest as reflecting the German point of view than for their actual content.

H. W. Gillett (15) -B-

Steel Plates. Catalog No. 132. Bethlehem Steel Co., Bethlehem, Pa., 1935. Fabrikoid, 6 x 9 inches, 362 pages. Price $1.00. Like the recently issued "Bethlehem Alloy Steels," this is not merely a catalogue but an engineering handbook. It gives a brief illustrated description of how plates are made, summarizes the standard specifications, discusses boiler design and many other engineering applications of plates, tubes, riveted and welded vessels, etc., with copious engineering data. In fact, over 80% of the book consists of tables and data. It might properly have been titled "Handbook of Steel Plates.

H. W. Gillett (15)-B-

Report for the Year 1934. National Physical Laboratory. Published by His Majesty's Stationery Office, London, 1935. Paper, 8 x 10½ inches, 260 pages. Price 13s.

In this annual account of the varied activities of the N. P. L. the reports of the metallurgy and the engineering departments are of principal interest. Particular attention is paid to the fundamentals of creep and of fatigue. The bulk of the metallurgical failures coming in for investigation continue to be from fatigue. The metallurgical subjects dealt with by the Laboratory are too numerous to mention here. Electron diffraction methods of study are being actively pursued and are expected to be fruitful.

H. W. Gillett (15) -B-

The Pneumonokonioses (Silicosis) Literature and Laws of 1934. G. G. Davis, E. M. Salmonsen & J. L. Earlywine. Chicago Medical Press, Chicago, 1935. Paper, 6 x 9 inches, 490 pages. Price $10.00.

This is a compilation of 394 abstracts of articles published in 1934 on silicosis, and 16 pages of recent laws and decisions, the whole prepared by a physician, a librarian and a lawyer. It is a supplement to a former volume published early in 1934. At the time of the 1934 publication suits against employers in the U. S. in alleged silicosis cases totaled some 300 million dollars. This collection of abstracts will be useful to those concerned with dusty metallurgical industries, whether they seek information on the occupational disease or on the "racket."

H. W. Gillett (15) -B-

Mining Pocket Dictionary (Bergtechnisches Taschenwörterbuch) English-German. W. Schulz, H. Louis & Goethe. Verlag Glückauf G.m.b.H., Essen, 1934. Board, 4¾ x 6¾ inches, 90 pages. This little dictionary, of about 5000 words, was prepared by the authors to fill the need of the German engineer who wants to keep in touch with the advancements made in English speaking countries.

The authors appreciate that a work of this kind is never complete, that new words are continually being coined to correspond with new conditions. They have therefore allowed several pages in the back of the book to add such words.

Richard Rimbach (15) -B-

Chemical Engineering Catalog. 20th Edition. Reinhold Publishing Corporation, New York, 1935. Cloth, 8½ x 11¼ inches, 863 pages. Price $10.00, except to special classes of technical men to whom it is lent gratis or sold for $3.00. A gay orange and blue binding distinguishes the latest edition of the Chemical Engineering Catalog from those heretofore published. Its contents, however, are classified as in preceding years:—Plant equipment, chemicals and raw materials, technical books, and a helpful list of trade names. A new departure is the separation of the index of chemicals and raw materials into two sections: (1) industrial chemicals and raw materials, and (2) laboratory and reagent chemicals, the second list referring to those firms who can supply chemicals in units of 25 lbs. or less. These two sections have been carefully cross-indexed.

An increase of more than 100 pages over the previous edition brings that much more information to the plant manager's desk, and is an encouraging sign that better times are here.

M. L. Moorman (15) -B-

Errors on Measuring Temperature with Thermocouples (Fehler bei der Temperaturmessung mit Thermoelementen). H. Euler & K. Guthmann. *Archiv für das Eisenhüttenwesen,* Vol. 9, Aug 1935, pages 74-90. 45 references. The following chief sources of errors are discussed. Ohmic resistance, a nomograph being given for determining this for various thermocouples. Poor connections. Warming of the cold junction. Poor protection from infiltrated air, etc. in installing the thermocouple. Oxidation, aging, and other chemical changes. Use of water for cooling the cold junction and of compensating leads may introduce stray currents. The principal German thermocouples are tabulated giving their advantages and range of usefulness. German metallic and non-metallic protection tubes are discussed.

SE (15)

Science in Industry (La Ciencia en la Industria). E. Jimeno & F. R. Morral. *Metalurgia y Construcción Mecánica,* Vol. 1, Oct. 1935, pages 3-4. The indispensable role of science in industry, particularly in metal industries, is discussed.

Ha (15)

Institute of Metals Annual General Meeting. *Metal Industry,* London, Vol. 46, Mar. 8, 1935, pages 269-270. A brief summary of the work of the 27th annual general meeting held Mar. 6-7, 1935, at the Institution of Mechanical Engineers, Storey's Gate, Westminster, S.W.1.

HBG (15)

Twin Calorimeter for Small Heat of Reactions (Zwillingskalorimeter für kleine Wärmetönungen). H. Gawlick. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Sept. 7, 1935, page 1089. Instrument and method of application are described; also useful for determination of specific heats.

Ha (15)

Corporation President Visualizes Future for Steel. William A. Irvin. *Heat Treating & Forging,* Vol. 21, Oct. 1935, pages 475-476. **New Vistas Open to Steel, Assuring Continued Growth.** *Steel,* Vol. 97, Oct. 7, 1935, page 17. From speech delivered at annual dinner of the American Society for Metals, Oct. 3, 1935. Reviews some fields in which enlarged use of steel, or its adjustments to new conditions, is receiving much attention, and advances made in metallurgy and in adaptation of improved mechanical equipment.

MS (15)

The Uses and Occurrences of Chrome. Gordon H. Chambers. *South African Mining & Engineering Journal,* Vol. 46, part I, Aug. 10, 1935, pages 708-709. General.

AHE (15)

Recent Trends and Future Developments in Metallurgical Research. Harold Moore. *Monthly Journal Institute of Metals,* Vol. 2, Mar. 1935, pages 139-156. Address before London local section of Institute of Metals. Discusses metallurgical research done within past 10 years and stresses need of continued work.

JLG (15)

Steel Mill and Customer. J. R. Miller. *Blast Furnace & Steel Plant,* Vol. 23, Aug. 1935, page 557; Sept. 1935, page 633; Oct. 1935, page 711. Discusses maintenance of contacts between steel producer and buyer with regard to matters of quality and service to the latter.

MS (15)

Mutual Value of Theory and Experiment in Metallurgy. S. Frederick Ravitz. *Mining & Metallurgy,* Vol. 16, Sept. 1935, pages 380-382. Paper was awarded the membership prize by the Utah section of the A.I.M.E. in 1934. Discusses advantages and limitations of theoretical and experimental methods of attacking metallurgical problems. These methods do not represent separate fields of investigation. By using theory as a guide to experiment much can be accomplished. Theoretical considerations expected to be of practical value should be based on accurate experimental facts, and should usually be tested by experiment.

VSP (15)

Metallurgical Progress. L. Sanderson. *Electrical Review,* Oct. 4, 1935, page 444. Summarizes developments in metallurgy of interest to the electrical industry.

MS (15)

Iron and Steel Works Engineering. J. A. Thornton. *Iron & Coal Trades Review,* Vol. 131, Oct. 18, 1935, pages 626-627. Presidential address to the Manchester Association of Engineers. The fundamentals of the metallurgy of Fe, engineering of coke oven, blast furnace and steel plants, power requirements for the operation and the coöperation needed between metallurgist and engineer are discussed.

Ha (15)

Elasticity, Structure and Strength of Materials. Part I. C. A. P. Turner. Published by the author, Minneapolis, Minn. (342 Builders' Exchange), 1934. Cloth, 6¼ x 9¼ inches, 416 pages. Price $6.00. One is tempted to poke fun at this book, as did the English reviewer who suggested for it a place between Leacock and Wodehouse; but the sympathetic reader will be moved to pity for a man who evidently has had ability, but who has spent so much time in writing a book full of the most absurd and fruitless speculation. The author has probably taken a great deal of pleasure in writing it, but it serves no other purpose.

M. Gensamer (15) -B-

Handbook of Inorganic Chemistry (handbuch der anorganischen Chemie). R. Abegg, F. Auerbach & I. Koppel. Vol. IV, part 3, section 3, sub-section 2. S. Hirzel Verlag, Leipzig, 1935. Paper, 6¾ x 9½ inches, pages 627-848. Price 30 RM. This is the second part of the section on cobalt. It is written by W. Palmaer and G. Starck and deals entirely with the complex cobalt amines, the section on cobalt alloys having been included in the previous sub-section. The present volume is of interest to chemists, but has nothing in it for the metallurgist.

H. W. Gillett (15) -B-

Indicating Pyrometers. M. D. Pugh. *Metal Industry,* London, Vol. 46, June 14, 1935, pages 647-649. In the many applications where, in the metal industry, pyrometric control is necessary, careful study of initial cost and upkeep are required in the selection of the type of pyrometer that best serves the requirements. This article summarizes the importance of temperature and outlines in general the types that can be used to best advantage in the average shop. The influence of temperature in hot dip galvanizing, in tinning, babbitting, machine soldering, die casting and in the non-ferrous foundry are briefly indicated. Methods of protecting the thermocouples are suggested. Some applications are cited where the stationary type is superior and some where the portable type can be used to the greatest advantage.

HBG (15)

15a. Economic

Occurrence of Platinum in Sulphidic Ores. O. E. Zviagintzev & A. N. Filippov. *Dokladui akademii nauk SSSR,* New Series, Vol. 3, Jan. 21, 1935, pages 130-132. In Russian. German translation on pages 133-135. The Pt content of individual samples of polymetallic and Cu ores from 17 different deposits within USSR of different character and geological origin varied from 11 to 0.0 g./metric ton. It was highest in hydrothermal and eruptive sulphides of acid magmas. The mean Pt content of ores from several deposits of the Allaverdi group (Transcaucasia) as determined on a great number of samples is less than 0.1 g./metric ton. ORS (15a)

Platinum and Allied Metals in 1934—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 379, Aug. 14, 1935, 5 pages. Pt refiners in the U. S. in 1934 purchased 2190 oz. from Alaska, 361 oz. from Calif., 132 oz. from Ore., 1 oz. from Wash. and 137 oz. from unspecified domestic sources, a total of 2821 oz. as compared with 508 oz. in 1933. They also purchased 12 oz. from Canada, 47,871 oz. from Columbia, 3595 oz. from S. Africa and 332 oz. from unspecified foreign sources. AHE (15a)

Possibilities for Tin Consumption in China. *Tin,* June 1935, pages 4-5. About 65% of the imports of Sn plate into Central and North China in 1934 were from the U. S., Great Britain supplying from 20 to 25%. Most of it is used by the oil companies. Establishment of Sn plate factories in Shanghai and Hongkong have been rumored. Eventual growth in Chinese canning industry is predicted. BWG (15a)

Tin Consumption in Russia. *Tin,* May 1935, pages 3-8; June 1935, pages 6-7. The 5,604 tons of Sn used in Russia in 1934, marking a 49% increase over 1933 consumption, was partly due to the recent tremendous increase in electrification. Additional demand for Sn is anticipated in furnishing equipment and electrical appliances which this wholesale power installation promotes. Planned production of 630,000 automobiles per year by 1937 will create a yearly demand for 1,600 tons of Sn. BWG (15a)

Russia Cites Growth in Iron, Steel; Sees U. S. Only Rival. *Steel,* Vol. 97, July 29, 1935, pages 13-14. Progress report on iron and steel industry of USSR presented by USSR Chamber of Commerce in a recent *Bulletin of Economic Information.* In March and April pig-Fe and steel output have, for the first time, exceeded 1,000,000 tons. Program calls for production of 16,000,000 tons pig-Fe and 17,000,000 tons steel in 1937. In 1935, there will be completed and placed in operation, 6 blast-furnaces with annual output of 1,790.000 tons pig-Fe, 34 open-hearth furnaces with annual output of 2,170,000 tons steel, 28 electric furnaces with annual output of 242,000 tons steel, 22 rolling-mills with annual output of 1,798,000 rolled products, and 5 pipe mills with annual output of 244,000 tons Fe pipe. MS (15a)

Roll Call Shows Slight Change. *Foundry,* Vol. 63, June 1935, pages 48, 50, 52, 55. A study of the foundry industry shows that while there has been a decrease in the number of foundries during the depression, the total loss is less than might have been expected. Reports of reopening idle establishments and new constructions testify to recovery of the industry. Includes a map showing the distribution of foundries by states and a table showing type foundries in each state in 1930 and 1935. VSP (15a)

The Need and Opportunity for Further Mechanization. *Automotive Industries,* Vol. 72, June 8, 1935, page 773. A review is given of the preliminary report on the study of the National Industrial Conference Board for the National Machine Tool Builders' Ass'n. This indicates that mechanization is not as widespread as many people believe and that increased development of machines, which means consumption of more metals, is desirable to raise the standard of living and diminish the amount of physical labor required per worker in industry. BWG (15a)

Total Mineral Production in 1934—Advance Summary. M. B. Clark. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 377, Aug. 2, 1935, 1 page. The mineral production of the U. S. in 1934 was valued at $3,350,000,000, an increase of 31% over 1933. Value of metal production increased 31.8% to $542,100,000. Production of practically all major mineral commodities increased in 1934; outstanding examples were Au and Ag. Prices generally increased, especially Ag, Au, Fe, and Cu. AHE (15a)

Coal and Steel in Belgium. N. S. Bryntiens. *Iron & Coal Trades Review,* Vol. 131, July 26, 1935, page 127. Review of conditions in 1934 in the Report of Overseas Trade (British). Ha (15a)

Iron Ore Deposits of Germany (Die Eisenerzvorräte des deutschen Reichs). H. E. Böker. *Glückauf,* Vol. 71, June 22, 1935, pages 590-592. A new survey made in 1931-32 estimates the total Fe ores at 721 million tons. Ha (15a)

Lead and Zinc in Canada in 1934. T. W. Bingay. *Canadian Mining & Metallurgical Bulletin* No. 281, Sept. 1935, pages 450-452. Statistical. AHE (15a)

Mining and Metallurgy in Sardinia (La Sardaigne minière et métallurgique). Ch. Berthelot. *Revue de Métallurgie,* Vol. 32, Aug. 1935, pages 342-350. Sardinia has considerable deposits of Pb and Zn ores and of kaolin besides numerous deposits of other minerals but of a smaller industrial interest. Galena is subjected to reducing fusion and the raw Pb produced is treated with Zn. The latter forms an alloy with Ag which floats. It is blown with steam which oxidizes Zn leaving metallic Ag. Zn ores are dissolved in H_2SO_4, their Fe is oxidized with $KMnO_4$ and precipitated with lime. The solution is electrolysed by Gambi process using Al cathodes and Pb anodes, producing a 99.92% Zn metal. Cd is also produced. Statistical data are given. JDG (15a)

The Mineral Industry During 1934. Edited by G. A. Roush. McGraw-Hill Book Company, New York, 1935. Cloth, 6¼ x 9½ inches, 739 pages. Price $12.00.

This annual compilation of reference data covers the developments, both foreign and domestic, in the mining and metallurgical fields. It presents production and trade statistics, technical improvements, extensions of plant, new sources and uses, market conditions, prices, etc.

The sections of interest to *Metals & Alloys'* readers with the authors are: Aluminum and Bauxite—C. L. Mantell; Antimony, Arsenic, Chromium, Manganese, Quicksilver, Zinc, Minor Metals—the Editor; Barium and Strontium—Charles Hardy; Cobalt— C. W. Drury; Copper—Percy E. Barbour; Utilization of Copper and Copper Alloys—Wm. G. Schneider; Metallurgy of Copper in 1934—Carle R. Hayward; Gold and Silver—H. N. Lawrie; Iron and Steel—George S. Herrick; Lead—Allison Butts; Metallurgy of Lead in 1934—Carle R. Hayward; Molybdenum—Alan Kissock; Nickel—Thos. W. Gibson; Platinum Group Metals—G. A. Roush; Radium, Uranium and Vanadium—Hugh S. Spence; Tin—E. Baliol Scott; Tungsten—Colin G. Fink.

A new feature added in this issue is a list of the current tariff rates on imported mineral and metal products. Richard Rimbach (15a) -B-

The Economic Minerals of Northern Rhodesia. *Mining Journal, Centenary Number,* 1935, page 107. A review. AHE (15a)

Nigeria's Minerals. *Mining Journal, Centenary Number,* 1935, page 116. Sn is the chief metal produced. Au, Fe and Pb occur. AHE (15a)

Manganese. *Mining Journal, Centenary Number,* 1935, page 54. A review. AHE (15a)

Platinum and Its Associated Metals. *Mining Journal, Centenary Number,* 1935, page 33. The economic history of Pt, Pd, etc. for the last 100 years is given. AHE (15a)

Rare Metals. *Mining Journal, Centenary Number,* 1935, page 47. A review covering Li, Be, Ti, Se Co, Te, and Ta. AHE (15a)

Tinplate in the Argentine. *Tin,* Aug. 1935, pages 20-21. Annual consumption (which is fast growing) and principal supply sources are discussed. Ha (15a)

The Steel Pact and After. *Engineer,* Vol. 159, June 21, 1935, pages 647-648. Editorial stating that the recent negotiations between the Continental and British steel manufacturers have been concluded. The terms are advantageous for the British makers. The present arrangements are to hold for a 5-year period but with 6 months' notice either side may break the agreement. Imports are reduced to about 600,000 tons per year and for each subsequent year they are reduced to 525,000 tons. See also editorial entitled "Steel Trade Reorganization" in *Engineer,* Vol. 160, July 26, 1935, pages 93-94. LFM (15a)

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Testing Precious Metals. C. M. Hoke. 2nd Edition. The Jewelers Technical Advice Co., New York, 1935. Paper, 5¼ x 8 inches, 60 pages. Price $1.00.

Written for those interested in identifying, buying, and selling precious metals, particularly Au, Ag, Pd, Pt, and their alloys. The procedure outlined involves making a streak of the unknown metal or alloy on a touchstone and comparing the action of reagents on the finely divided metal of the unknown with known compositions, which are called needles. The problem of identifying and evaluating precious metals has become more complicated by the introduction of green gold, white gold, stainless steel, and the alloys which contain metals of the Pt group or Ni. Chap. 1 outlines the old touchstone method for Au and Ag. Standard needles of the usual compositions of gold-colored, white, and green-gold alloys are available. Stainless steel can be differentiated from white golds and Pt by lack of "heft" and by its solubility in HCl. Since white golds are generally whitened by Pd or Ni, it is necessary to determine which was used, because the former is more valuable. The method is outlined in Chap. 4.

Chap. 2 gives the applications of the flame test, specific gravity, the magnet, and the significance of carat or quality markings. Chap. 3 deals with the detection and estimation of Pt, Pd, and Au, and depends largely upon the reaction of stannous chloride on solution of the unknowns in aqua regia. Chap. 4 outlines a method of differentiation between Pd and Ni by using a solution of dimethyl-glyoxime called "DMG." Pd forms a precipitate in acid solution, while Ni does not form a precipitate until the solution is made alkaline.

Part II, pages 35-47, is a general discussion of the buying and selling of old Au, Ag, and Pt, and gives some information on government regulation. Part III is an appendix giving terms and tables used in connection with the precious metals.

This book should be of interest to those who deal in precious metals of unknown value and composition, and the extension of this type of testing to metals other than gold should be of particular value. The methods do not give strictly quantitative data and cannot be used to take the place of assays. O. E. Harder (15a)-B-

The Scrap and Old Metal Question in Present-day and Future Metal Founding (Die Abfall- und Altmetallfrage in der heutigen und künftigen Metallgiesserei). Willi Claus. *Giesserei,* Vol. 22, Aug. 16, 1935, pages 409-411. The value of the various kinds of scrap and waste metals and alloys and their further use in melting are discussed with particular regard to national-economic conditions in Germany to save costly metals which have to be imported. Ha (15a)

Summary of Mineral Production. M. B. Clark. *United States Bureau of Mines, Statistical Appendix to Minerals Yearbook,* 1934, pages A1-A41. AHE (15a)

Cost of Stainless Ware. Paul D. Ffield. *Metal Progress,* Vol. 28, July 1935, page 54. Comments upon the high cost of spun domestic articles of stainless steel compared to Al in America and competitive prices in England. WLC (15a)

Metal Mining in Utah in 1934—Advance Summary. C. N. Gerry & T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 393, Aug. 20, 1935, 5 pages. The value of Au, Ag, Cu, Pb and Zn from Utah mines in 1934 was $22,915,534, an increase of nearly 41% over 1933. Production of Au increased about 25% to 136,581.52 oz., Ag about 25% to 7,111,417 oz., and Cu about 17% to 86,024,925 lbs.; Pb decreased 1% to 116,153,945 lbs. and Zn 5% to 56,396,279 lbs. AHE (15a)

Metal Mining in Washington in 1934—Advance Summary. C. N. Gerry & T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 394, Aug. 21, 1935, 2 pages. The value of Au, Ag, Cu, Pb, and Zn from Washington mines in 1934 was $506,945 compared with $468,653 in 1933. Au output increased 82% to 8,301.83 oz., Ag from 18,520 to 44,120 oz., and Cu from 5,781 to 13,900 lbs.; Pb production decreased from 1,680,430 to 581,298 lbs., and Zn from 6,738,169 to 3,852419 lbs. AHE (15a)

Mine Production of Silver in the United States, 1934 (Advance Summary). Chas W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 392, Aug. 21, 1935, 3 pages. The Ag output in 1934 was 32,740,642 oz. as compared with 23,310,154 oz. in 1933. Idaho, Utah, Arizona, Montana, Colorado, Nevada, New Mexico, Texas, and California produced 98% of the total production. AHE (15a)

Mine Production of Gold in the United States, 1934 (Advance Summary). Chas W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 391, Aug. 21, 1935, 3 pages. The Au output in 1934 was 3,108,478.17 oz. as compared with 2,571,259.02 oz. in 1933. California, Alaska, South Dakota, Philippine Islands, Colorado, Arizona, Nevada, Utah, Montana and Idaho produced 97% of the total. AHE (15a)

The Economic Importance of the Replacement of Obsolete Equipment in Steel Mills. D. M. Petty. *Preprint American Iron & Steel Institute,* May 1935, 20 pages; *Iron Age,* Vol. 135, May 30, 1935, pages 44-47, 80-85; *Steel,* Vol. 96, May 27, 1935, pages 45-46, 48-50, 68. Causes of replacements are (1) wear, (2) non-production of satisfactory consumer product, (3) cost of production on the unit high and profits low, (4) insufficient capacity. These various factors and their applications to steel mills are discussed in detail. VVK + VSP + MS (15a)

Metallurgical Industry in Czecho-Slovakia (Quelques Aspects de l'Industrie Métallurgique Tchécoslovaque). Paul Bastien. *Bulletin de l'Association Technique de Fonderie,* Vol. 9, July 1935, pages 222-232. Paper presented before the A. T. F., May 14, 1935. An account of a trip through Czecho-Slovakia. Ore deposits, blast furnaces and foundries are described. Vitkovice, Skoda, and Ceskomoravska-Kolben-Danek plants were principal ones visited. WHS (15a)

The Lead Industry and Witch Burning. Clinton H. Crane. *Mining & Metallurgical Society of America,* Bulletin 229, Vol. 27, Apr. 1934, pages 49-52. Economics of the Pb industry are discussed. AHE (15a)

Metal Mining in California in 1934—Advance Summary. F. W. Horton & H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 405, Sept. 25, 1935, 5 pages. Statistical. AHE (15a)

Statistical Appendix to Minerals Yearbook 1934. O. E. Kiessling *et al. United States Bureau of Mines,* 1935, 434 pages. Statistical. AHE (15a)

Ore Concentration—(Advance Summary). T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 416, Nov. 15, 1935, 4 pages. Statistical. AHE (15a)

Nickel in Canada in 1934. J. C. Nicholls. *Canadian Mining & Metallurgical Bulletin,* No. 283, Nov. 1935, pages 561-565. Statistical. Uses are discussed. AHE (15a)

Nickel—and the United States—A Brief Survey of the Country's Present Position with Respect to the Essential Commodity. G. W. Pawel. *Engineering & Mining Journal,* Vol. 136, Sept. 1935, pages 459-462. The U. S. is the largest consumer of Ni, yet it has no matte refining capacity. Several promising deposits of Ni exist in American soil, particularly in Alaska. WHB (15a)

Statistical Review of Ontario's Mineral Industry in 1933. W. R. Rogers & A. C. Young. *Annual Report Ontario Department of Mines,* Vol. 43, Part I, 1935, pages 1-46. Statistical. AHE (15a)

Die Casting and Trade Recovery. E. Stevan. *Metal Industry,* London, Vol. 46, May 24, 1935, pages 553-554. Die casting is an important factor for those industries that must, from necessity, develop cheaper methods of manufacture to compete with products developed by cheaper labor. While the major portion of die cast products are made from white metals, the quantity of brass and Al-bronze is increasing. Discussion of Zn-base alloys includes physical properties and possible applications. The accuracy of the process and its advantages are considered. HBG (15a)

Tower Sees Steel House as Aid to Warehousing Problem. Walter S. Tower. *Steel,* Vol. 97, Nov. 4, 1935, page 25. Abstract of address before National Wholesale Hardware Association. Steel distributor appears to be logical channel for handling prefabricated house or steel for houses, rather than fabricator or general building supply yard. This will compensate distributor for losses that may be realized by changes in steel distribution through mill-owned warehouses and specialization in steels. More flexible mill schedules and better delivery service tend to limit need for distributor. Warehousemen should urge on producers complete elimination of "jobber's deduction." Specialization in composition and forms of steel makes difficult maintenance of warehouse assortments and adds to capital requirements. MS (15a)

Mine Production of Gold, Silver, Copper, Lead, and Zinc in Arizona in 1934 (Advance Summary). C. N. Gerry & Paul Luff. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 417, Nov. 6, 1935, 3 pages. Statistical. AHE (15a)

Mining and Minerals in China. Report of the Department of Overseas Trade 1933-1935. *Iron & Coal Trades Review,* Vol. 131, Nov. 8, 1935, page 771. Reviews mineral resources, developed and undeveloped, existing plants, transportation facilities, and production. Special figures are given for W, Sn and Fe. Ha (15a)

Houses of Steel. B. Chapple. *American Metal Market,* Vol. 42, Aug. 29, 1935, page 6. Physical and economical features of houses fabricated of steel are discussed and present development is described briefly. Ha (15a)

Gold and Silver in Canada in 1934. G. C. Bateman. *Canadian Mining & Metallurgical Bulletin* No. 282, Oct. 1935, pages 517-519. An economic discussion. AHE (15a)

History Proves Time to Rehabilitate Equipment Is During Depression. M. I. Arms. *Steel,* Vol. 97, Oct. 7, 1935, pages 46-47. Past experience and knowledge of present economic conditions indicate that now is the right time to modernize steel plants. MS (15a)

The Future of Tin, II. *Tin,* Sept. 1935, pages 1-4. Sources of supply are reviewed. Bolivian tin, from primary deposits, is relatively expensive to produce compared to dredging from Malayan alluvial deposits. Nigeria, once a high cost producer, is now one of the lowest cost producers. BWG (15a)

Antimony Industry in 1934—Advance Summary. F. M. Shore & H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 404, Sept. 11, 1935, 2 pages. Statistical. AHE (15a)

The Economic Position of Lead. Ludwig Vogelstein. *Mining & Metallurgical Society of America, Bulletin* 229, Vol. 27, Apr. 1934, pages 52-57. General. AHE (15a)

Canadian Iron and Steel Industry, Its Structure and Output. *Iron & Coal Trades Review,* Vol. 131, Oct. 11, 1935, pages 592-593. Statistics on production from 1913 to 1933 are given. Ha (15a)

The Non-Ferrous Smelting and Refining Industry in Canada in 1934. *American Metal Market,* Vol. 42, Oct. 11, 1935, page 6. Statistics on metal and mineral productions, mainly Au, Ag, Cu, Zn, Cd, Bi, fertilizers. Comparison with world production and review of labor and manufacturing conditions in individual plants. Ha (15a)

Titanium (O Titanio). A. Furia. *Chimica e Industria,* Vol. 3, Aug. 1935, pages 84-85. The deposits of Ti ores in Brazil are described. The world production of Ti rose from 5000 tons in 1920 to 70,000 tons in 1933. Ilmenite contains from 45 to 52% Ti as TiO_2Fe, rutile contains Ti as TiO_2; other complex ores exist but are of little value. Principal users of Ti are the steel industries and manufacturers of pigments, and the salts are used in dyeing and in the textile industry. Ha (15a)

Mine Production of Gold, Silver, Copper, Lead and Zinc in Idaho in 1934 (Advance Summary). C. N. Gerry & T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 410, Oct. 23, 1935, 4 pages. Statistical. AHE (15a)

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■ 15b. Historical ■

Man and Metal. William J. Larke. *Foundry Trade Journal,* Vol. 53, July 11, 1935, pages 26-30. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 466R/10. AIK (15b)

The Origin of Metal Alloying. Ernest A. Smith. *Metal Industry,* London, Vol. 46, Apr. 5, 1935, pages 375-377. The mixing of 2 or more metals in order to produce an alloy possessing properties superior to its components is so universally common that it is difficult to visualize a time when "alloys" were not available. Only recently, when by chemical analyses, have data been obtainable relative to the alloys of the ancients. The earliest metals known to man were Au, Ag and Cu which occur in Nature. From prehistoric days Au and Ag have been used for ornamental work and Cu, as more utilitarian, was used for making weapons, tools and utensils. From earliest times, by the primitive smelting of complex ores, alloys of definite composition were produced. There is little doubt that the first alloys intentionally alloyed were the precious metals and a number of Au and Ag objects recently discovered at Ur of the Chaldees, dating 4000 or more years before the Christian era, confirm this. The beauty and skillful technique required to produce these objects indicates that the development must have gone back many generations. "Electrum," Au alloyed with 20-30% Ag, appears to have been much prized by the ancient goldsmiths and some of the objects found at Ur are of this composition, which is very similar to the green Au used by modern jewelers. Recent discoveries show that this alloy was no mere accident but was intentionally employed for decorative purposes by the craftsmen of Ur. Pliny (23-79 A.D.) states that this alloy was prepared artificially as well as, in some places, found in nature. The ancient Greeks used this alloy, obtaining their supplies from the auriferous sands of Italian rivers. Bronze was probably the earliest metal alloy applied to useful purposes and was used long before Sn was known. The earliest bronzes vary in Sn-content and analyses of some of the earliest Sumerian objects so far discovered belong to the period of 500-3000 B.C. The Mossynoeci made brass in about 300 B.C., at least 1800 years before Zn was recognized as a metal. A Ni-Cu, known as "white Cu," a forerunner of modern German or Ni-Ag, was smelted direct from a complex ore, at least as early as 235 B.C. The profound secrecy which surrounded all processes of metal extraction and fabrication in early days probably accounts for the lack of information, now obtainable on the production of alloys, until the days of the alchemists. 5 references. HBG (15b)

Iron and Steel. W. J. Larke. *Nature,* Vol. 136, July 6, 1935, pages 19-26. A lecture on the history of production of iron and steel from 4000 B. C. to date. CSB (15b)

A Share Transfer of 1288 A.D. *Iron & Coal Trades Review,* Vol. 131, Aug. 30, 1935, page 319. Letters of transfer of a copper mine in Sweden, and the extent of Cu mining in that country at that time and developments up to present day are briefly discussed. Ha (15b)

Waste-Wax Casting. E. A. Smith. *Foundry Trade Journal,* Vol. 53, Aug. 1, 1935, page 80. The earliest practice of art metal casting dates from prehistoric times. The waste-wax or lost wax (cire perdu) method has been applied from very early times to artistic metal casting and forms an important link with the past history of foundry practice. It would not be unreasonable to conclude that the "cire perdu" method was in use some 4000 or 5000 B.C. The intrinsic interest in this method is enhanced by the remarkable discovery in recent years of certain castings in Au, Ag, and Cu at the ancient city Ur of the Chaldees in Southern Mesopotamia. AIK (15b)

Ten Years' Metallurgy and Technology of Iron (Zehn Jahre Metallurgie und Werkstoffkunde des Eisens). R. Walzel, R. Mitsche & H. Pessl. *Berg- und Hüttenmännisches Jahrbuch,* Vol. 83, Aug. 25, 1935, pages 61-76; *Montanistische Rundschau,* Vol. 27, July 1, 1935, 2 pages. Progress and new developments of blast furnace methods, reduction processes and theories, metallographic properties and means of making them visible, methods of determining slag inclusions in steel, measuring methods for mechanical properties, prevention of intercrystalline corrosion of austenitic stainless steels by preventing the precipitation of Cr carbides, development of tool steels and steels for permanent magnets, progress made in resistant cast irons, and standardization in Germany are reviewed exhaustively. 34 references. Ha (15b)

The Oxy-Acetylene Process in Steel Making 1901 to 1935. *Oxy-Acetylene Tips,* Vol. 14, Nov. 1935, pages 245-249. Historical notes on the use of O and oxy-acetylene in open-hearth operations. Ha (15b)

Alfred Wilm, Inventor of Duralumin (Alfred Wilm, der Erfinder des Duralumins). *Aluminium,* Vol. 17, Sept. 1935, pages 502-508. Biography of Wilm and historical development of the Al-Mg alloys with Cu and Mn addition. Ha (15b)

Free Service Department

For Readers of

METALS & ALLOYS

Wanted:—By a well-known manufacturer of Heat and Acid Resisting Castings Sales Representatives who are acquainted with buyers and operating heads in the Steel, Automobile, Chemical and Oil Industries in the following territories: New York, Boston, Philadelphia, Chicago, Cincinnati, Houston and Birmingham. No objection to one or two more lines. Reply giving references and full information as to qualifications. Address Box MA-2, Care of Metals & Alloys, 330 W. 42nd St., New York, N. Y.

Carbofrax

Leaflet illustrating Carbofrax standard brick shapes and plain tile. Tables of sizes. The Carborundum Company, Niagara Falls, N. Y. (163)

Flex-Arc Rays

Data bulletins containing information on arc welding are published by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. (164)

Perfect Castings

Ajax Process Ingot Metals are recommend as the foundation of perfect castings. Either Ajax Standard Formula or the user's formula can be specified. Ajax Metal Co., Philadelphia, Pa. (165)

Refractory Cement

A leaflet pictures the results of a test performed on five brands of refractory cement which were trowelled on a tile and fired at 2700 deg. F. Charles Taylor Sons Company, Cincinnati, O. (166)

Industrial Friction Materials

A brochure, FM-4A, contains brief descriptions of the complete line of industrial friction materials, including the woven and compressed and the folded and compressed products of the flexible types and the friction block and moulded varieties of the rigid styles. Illustrated. Johns-Manville, New York, N. Y. (167)

Piston Replacement

T-slot pistons, cam grinding, Lo-Ex alloys and Alumilite finish are discussed in an attractive pamphlet. Aluminum Co. of America, Pittsburgh, Pa. (168)

The Jetal Process

Simple immersion in an aqueous bath for about 5 minutes colors all grades of common iron or steel a brilliant and uniform jet black. It is claimed it does not alter dimensions of articles and cannot chip, scale, peel or discolor. Alrose Chemical Co., Providence, R. I. (169)

American Electric Furnaces

This catalog contains data on construction and operation. American Electric Furnace Co., Boston, Mass.

Published by the same firm: "Juthe Gas Furnaces" are described in this illustrated catalog. (170)

Industrial Furnaces

This catalog describes, illustrates and gives specifications for furnaces suitable for various applications. Mahr Manufacturing Co., Minneapolis, Minn. (171)

Stewart Industrial Furnaces

Catalog No. 105 is devoted to these furnaces, whose linings are extra heavy and made from selected refractories chosen for adaptability to the special conditions and uses called for in each furnace. It is claimed that they are economical of fuel, convenient to operate and dependable through and through. Chicago Flexible Shaft Co., Chicago, Ill. (172)

Low Power Binocular Microscopes

An illustrated catalog deals with these microscopes whose prisms are secured in the prism boxes in such a way as to insure stability and the convergence at the eyepiece is but 8 deg., which makes it possible to work for long periods without eyestrain. Spencer Lens Co., Buffalo, N. Y. (173)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (174)

Welding Rods

Hard-facing welding rods Nos. 459 and 217 are the subjects of an illustrated brochure. Hard surfacing can be done with these rods, either electrically or by the oxy-acetylene process to the great majority of ferrous welding parts. American Manganese Steel Co., Chicago Heights, Ill. (175)

Better Castings

Interesting information is contained in this publication which is distributed by the Niagara Falls Smelting and Refining Corp., Buffalo, N. Y. (176)

Aerocase

Booklet on this subject. Illustrations, curve charts, tables. American Cyanamid and Chemical Corp., New York, N. Y. (177)

U S S High-Tensile Steels

Pamphlet describing high-tensile steels developed to meet the need of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (178)

Blue Book of Thermometals

This book contains a review of specifications, properties and methods of application of modern thermostatic bimetals, assembled for convenient reference. Complete mechanical, thermal and electrical characteristics for all standard types of Wilco thermometals are included. H. A. Wilson Co., Newark, N. J. (179)

Research in the Effect of Operating Temperatures on the Combustion of Industrial Gas

Report No. 748 is the second bulletin dealing with Project No. 26. This bulletin summarizes the subject matter of the first bulletin and contains considerable original information concerning a large number of additional variables influencing the operating temperatures and combustion of industrial gas. Well illustrated. American Gas Association, New York, N. Y. (180)

Centrifugal Castings

Bulletin C-2 is devoted to these castings which are available in the same analyses as the stationary-cast range of heat and corrosion resistant alloys which they supplement. Michigan Steel Casting Co., Detroit, Mich. (181)

What Scientists Say of Leitz Ultropak

Bulletin No. 17 describes the personal experiences and applications to which Ultropak has been placed by scientific workers in various fields. Profusely illustrated. E. Leitz, Inc., New York, N. Y. (182)

The Shaft . . .

The January, 1936, number is full of good advice for the New Year. Interesting reading. Summerill Tubing Co., Bridgeport, Pa. (183)

High Temperature Insulation

For all types of heated equipment is the subject of an illustrated leaflet issued by Armstrong Cork Products Co., Lancaster, Pa. (184)

Pure Carbide-Free Metals

These metals are described and applications suggested in Pamphlet No. 20. Heating Thermit Cans are also described and illustrated. Metal and Thermit Corp., New York, N. Y. (185)

Molybdenum in Iron and Steel

An attractive brochure contains a summary of the part played by molybdenum in ferrous progress, and claims that a great saving in cost with no impairment in quality can be obtained by its use. The Climax Molybdenum Co., New York, N. Y. (186)

Phosphor Bronze

A leaflet lists the sizes in which this company's twelve inch stock bushing bars are now offered. The Phosphor-Bronze Smelting Co., Philadelphia, Pa. (187)

Brazing Alloy

Bulletin No. 5 advocates the use of "Sil-Fos" for joining brass, bronze, nickel, nickel silver, extruding brass and bronze. Monel metal and other non-ferrous metals and alloy fusing above 1300 deg. F. Handy & Harman, New York, N. Y. (188)

Optical Pyrometer

The Burrell optical pyrometer, a direct reading instrument originally designed for use with the Barrett fusion furnace and equally useful for other work requiring an optical pyrometer with a temperature range from 1500 to 3000 deg. F., is described and illustrated in a leaflet published by the Burrell Technical Supply Co., Pittsburgh, Pa. (189)

Ladle Fluxes

The advantages of using fluxes for aluminum, brass, bronze, copper, nickel, iron and special alloys are listed in a leaflet of The Maluminum Co., Indianapolis, Ind. (190)

Torsion Impact Testing Machine

Bulletin No. 114 discusses the Carpenter machine whose operation is very simple and requires only one operator. Baldwin-Southwark Corp., Philadelphia, Pa. (191)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (192)

Coreless Induction Furnace

A colorful leaflet contains an explanation of the principle of operation and advantages to be obtained from the use of the Ajax-Northrup electric furnaces. Ajax Electrothermic Corp., Trenton, N. J. (193)

Blast Gates

Looseleaf page No. 353 is devoted to this company's Kwikleen gates, which, it is claimed, can handle low pressure air and liquids carrying a large percentage of solids, which would clog or jam an ordinary gate, and are styled to suit the service. W. S. Rockwell Co., New York, N. Y. (194)

Lithorizing

Leaflet setting forth this process for making paint hold to galvanized iron. American Chemical Paint Co., Ambler, Pa. (195)

Muffle Furnaces

The construction, control and operation of the Alloy 10 furnace are described in a pamphlet which claims that this furnace is efficient for all laboratory operations requiring temperatures to 2400 deg. F. Illustrated. Hevi Duty Electric, Milwaukee, Wis. (196)

Liquitol

Bulletin A1-16-A deals with the use of Liquitol for iron and steel castings and ingots. Alpha-Lux Co., Inc., New York, N. Y. (197)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (198)

Permite Six Foot Cast Bronze Bars

An attractive booklet states that these bars assure a product identical in physical and wear resisting qualities with the finest individual castings. Data on uses and properties of various bronze alloys are included. Joseph T. Ryerson and Son, Inc., Chicago, Ill. (199)

Alloy Steel Castings

Information on corrosion resistance and technical data on Durimet and Durco Nirosta are included in a well illustrated bulletin of The Duriron Co., Inc., Dayton, O. (200)

Optical Aids in the Metal Working Industry

An attractive, illustrated leaflet contains a listing of some of the more generally applicable optical aids for the metal working industry developed by this company. The Toolmakers' microscope, designed for the needs of the workshop as well as the mechanical laboratory and the Optical Drill Gage are among the items described. Bausch & Lomb Optical Co., Rochester, N. Y. (201)

Standard Gas Fired Air Heaters

Publication SC-70 is devoted to these heaters which, it is claimed, are applicable to all low temperature heating operations which may be accomplished by the circulation of heated air and where contact of the material being heated with diluted products of combustion is not objectionable. They may be applied to batch type or continuous ovens or kilns, rotary or cylindrical dryers, towers, rooms or any enclosed space in which heating or drying is to be done. Surface Combustion Corp., Toledo, O. (202)

Electric Furnaces

A pamphlet describes the "Certain Curtain" furnace which was developed for heat treating at temperatures between 1850 and 2500 deg. F. C. I. Hayes, Inc., Providence, R. I. (203)

Free Cutting Brass Rods

Anaconda publication B-14, second edition, lists in detail the advantages of brass for screw machine products. American Brass Company, New York, N. Y. (204)

New Method Annealing

Pamphlet containing data on this method. Illustrated. Power curves, comparison of annealing costs, etc. The Bellis Co., Branford, Conn. (205)

Atmospheric Burners

Bulletin 133-3 is concerned with the Sincro Venturi Atmospheric Burners and Immersion Burners. Illustrated. Philadelphia Drying Machinery Co., Philadelphia, Pa. (206)

Metallurgy of Wire Manufacture

This paper contains valuable and interesting data and was presented by H. W. Graham, general metallurgist of Jones & Laughlin Steel Corp., Pittsburgh, Pa. (207)

Grinding for the Railroad Shop

The trend toward improvements in convenience, passenger comfort, service and speed calls for greater mechanical perfection in equipment. As grinding is the recognized means of obtaining accurate, close-fitting and long-wearing parts at minimum costs it is rapidly coming into more general use by the railroads according to an attractive pamphlet of the Norton Co., Worcester, Mass. (208)

The Brackelsberg Furnace

Bulletin No. 197 is devoted to the above subject. How this furnace lowers the cost of quality castings, other important advantages and design and operation are discussed. Illustrated. Whiting Corp., Harvey, Ill. (209)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (210)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-ray has now come to the fore as a tool of the testing laboratory. Kelly-Koett Mfg. Co., Inc., Covington, Ky. (211)

Dolomite Refractories

This interesting pamphlet presents the case of Clinkered vs. Calcined Dolomite in the basic open-hearth steel furnace. Basic Dolomite, Inc., Cleveland, O. (212)

Refractory Cement

Bulletin No. 317, describes Q-Chrome neutral-base refractory cement which was designed for severe-service duty. Quigley Company, Inc., New York, N. Y. (213)

Kramer Alloy News

Interesting data are found in this publication. Humor is not forgotten. H. Kramer & Co., Chicago, Ill. (214)

Optical Instruments

Catalog L-2 lists those instruments for which there is a regular demand. Among the subjects listed are: Spectrometers, X-ray spectrometers, spectroscopes, wave length spectrometers, infra-red spectrometer and monochrometer, spectrometer accessories, etc. Illustrated. An index is included. Gaertner Scientific Corp., Chicago, Ill. (215)

Casting Design

Bulletin No. 2 contains important facts on casting design and selection of gear materials. It is claimed that Meehanite is taking the place of cast and forged steel, semi-steel and bronze for cast to form, cut gears, spur, bevel and worm gears because of its better combination of physical properties and its inherent economy. Meehanite Metal Corp., Pittsburgh, Pa. (216)

Bimetal

A simplified version of its manufacture, and the way it works is contained in this pamphlet. W. M. Chace Co., Detroit, Mich. (217)

Sonittep Products

This booklet discusses heat loss and its control. The advantages of Sonittep insulating cement and its uses are listed. Instructions for its application are included. Graphs. George F. Pettinos, Inc., Philadelphia, Pa. (218)

Thermal Expansion Characteristics of Some Nickel Cast Irons

The above article is reprinted in Section 3, No. 6 of the Nickel Cast Iron Data leaflets published by The International Nickel Co., Inc., New York, N. Y. (219)

Agathon Alloy Steels

This new handbook presents up-to-date metallurgical and chemical data on standard and special steels and outlines factors to be considered in their selection and heat treatment. Applications of alloy steels for specific uses in leading industries are discussed. Illustrated. Republic Steel Corp., Massillon, O. (220)

Pattern Data Required for Estimation of Costs

This pamphlet shows what data should be supplied by the users of castings to assist a malleable foundry in developing the right kind of patterns to make satisfactory castings. The Lake City Malleable Co., Cleveland, O. (221)

Gas Fired Cyclone Furnace

This furnace is a companion to the electrically heated Cyclone furnace for the tempering of carbon or high speed steel, for annealing brass, copper and aluminum, and for other temperature applications below 1250 deg. F. which require accurate temperature control and close temperature uniformity. Illustrated. Lindberg Engineering Co., Chicago, Ill. (222)

Acid Proof Cement

Booklet No. 1, which contains the statement that "Penchlor Acid Proof Cement is the only sodium silicate cement which is entirely resistant to steam, hot or cold water, hot or cold salt solutions of all strengths, and hot or cold acids of all strengths," gives pertinent data on the subject. Pen-Chlor, Inc., Widener Bldg., Philadelphia, Pa. (223)

CURRENT NEWS ITEMS

The Low-Alloy, High Elastic Steels

The subject of the low-alloy, high tensile or high elastic steels will be a prominent topic at coming sessions of technical societies.

At the annual meeting of the American Institute of Mining and Metallurgical Engineers in New York in February, a symposium on "Metals in New Transportation" is scheduled for Thursday morning and afternoon, Feb. 20. The program includes on opening address by A. J. Pelley, president of the American Association of Railroads and one on "Trends in the Metallurgy of Low-Alloy, High-Yield Strength Steels" by Dr. H. W. Gillett. There are also two papers on non-ferrous meals, the heavier and the light, by C. H. Mathewson and Dr. Zay Jeffries respectively. At a session on General Metallurgy on Wednesday morning, Feb. 19, "Choosing a Composition for a Low-Alloy, High Strength Steel" will be discussed by S. Epstein, J. H. Nead and J. W. Halley.

At the annual Regional Meeting of the American Society for Testing Materials in Pittsburgh, March 4, a symposium has been arranged on "High Strength Constructional Metals." The low-alloy steels will be discussed by a paper on "Carbon and Low-Alloy Steels" by Edwin F. Cone, while the "Corrosion-Resisting Steels" will be treated by E. E. Thum. Other papers on this program include "Alloys of Copper" by H. A. Bedworth, American Brass Co., "Aluminum and Magnesium Alloys" by E. H. Dix, Jr. and "Nickel and Its Alloys" by A. J. Wadhams.

The New York section of the American Welding Society will hold a meeting on March 10 at which the low-alloy, high elastic steels will be discussed by Dr. A. B. Kinzel and other speakers, with E. F. Cone as chairman.

Engineers and Foundrymen to Meet in Birmingham

The Fourth Annual Foundry Practice Conference, sponsored by the Birmingham, Ala. section of the American Society of Mechanical Engineers in cooperation with the American Foundrymen's Association, will be held Feb. 27 and 28. One day has been set aside for plant visitation to the many important foundries and manufacturing plants of this outstanding iron and steel center. Technical sessions will be held to discuss foundry and castings developments and outstanding nationally known speakers will appear on the program.

The chairman of the Birmingham Section of the A.S.M.E. is Joseph W. Eshelman, the vice chairman being Thomas J. Carpenter, Republic Steel Corporation. Mr. Carpenter is chairman of the Foundry Meeting Committee and, serving as co-chairman, representing the Foundry interests, is R. R. Deas of the American Cast Iron Pipe Company.

This Conference will be the occasion for the formation of the Birmingham District Chapter of the A.F.A., which is being sponsored under the leadership of L. N. Shannon of the Stockham Pipe Fittings Company.

The Great Lakes Exposition

The romance of the iron and steel industry will be the central theme of a great three-month industrial exposition to be held next year at Cleveland during July, August and September. The event will celebrate the centennial year of the city and is expected to draw large exhibits from industry in the Great Lakes region. Men, prominent in the steel and allied industries who are on the exposition organization committee, include T. M. Girdler, Republic Steel Corp.; E. J. Kulas, Otis Steel Co.; H. A. Dalton, Youngstown Sheet & Tube Co.; Fred H. Chapin, National Acme Co.; Elton Hoyt II, Pickands Mather Co.; L. W. Greve, Cleveland Pneumatic Tool Co.; and Alva Bradley.

The exposition, the largest civic event in the history of Cleveland, will be staged on 80 acres of the downtown Cleveland lakefront. The huge Public Hall and Underground Exposition Hall and the Municipal Stadium will also be used. The purpose is to present a cross section of the industrial, commercial, cultural, educational and social life and progress of the Great Lakes area.

A.F.A. Nominates Officers and Directors

At a meeting of the nominating committee of the American Foundrymen's Association, in Cleveland, Jan. 13, James L. Wick, Jr., president and general manager, Falcon Bronze Co., Youngstown, Ohio, was nominated for president of the association for the years 1936-37. Mr. Wick at present is vice president of the Association and has long been active in its work. His particular interest has been in cost work and he headed this A.F.A. committee for many years. In addition to Mr. Wick, the following members were nominated as officers and directors:

For Vice President: H. Bornstein, chief chemist and metallurgist, Deere & Co., Moline, Ill.

For Directors to Serve for Three Years: Marshall Post, vice president, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; L. N. Shannon, vice president and production manager, Stockham Pipe & Fittings Co. Birmingham, Ala.; James R. Allan, assistant manager, industrial engineering and construction dept., International Harvester Co., Chicago; C. C. Gibbs, president, National Malleable & Steel Castings Co., Cleveland; and Dan M. Avey, editor, *The Foundry*, Cleveland. Mr. Avey is now president of A.F.A. and will retire on the election of a successor after serving two successive terms.

Republic Moves to Cleveland

Effective January 25, the general offices of Republic Steel Corporation were removed from Youngstown to Cleveland, Ohio, as announced by T. M. Girdler, president and chairman of the board of Republic. The offices occupy floors 13 to 16 inclusive in the former Medical Arts Bldg., recently renamed the Republic Bldg.

The move consolidates the general offices which have been located in Youngstown, the executive and Cleveland district sales offices formerly in the Union Trust Bldg., Cleveland, and the Advertising Dept., Massillon, Ohio. The sales offices of the Newton Steel Co. will also be located in the Republic Bldg., Cleveland.

The sales offices of the Alloy Steel Division will remain in Massillon, Ohio.

Metal Congress for Cleveland in October

The 1936 National Metal Congress and Exposition, to be held in Cleveland's Public Auditorium, will be staged October 19 to 23, inclusive. This was announced definitely today by W. H. Eisenman, managing director of the Exposition and national secretary of the American Society for Metals, which annually sponsors this event. Five large technical societies cooperate to stage this annual event—the American Welding Society, the Wire Association, the Institute of Metals and Iron and Steel divisions of the American Institute of Mining and Metallurgical Engineers, and the American Society for Metals.

The Perkin Medal Award

The Perkin Medal of the Society of Chemical Industry was presented to Prof. Warren K. Lewis at a meeting of the society on Jan. 10, 1936, held jointly with the American Chemical Society at the Chemists' Club, New York. Professor Lewis is on the faculty at the Massachusetts Institute of Technology. The award has been made in recognition of his creative activities as the father of modern chemical engineering and his training of and inspiration to many of the present and potential leaders in the profession.

The **American Chemical Society** has announced the appointment, as assistant manager, of **Alden H. Emery,** now assistant chief engineer, Experiment Stations Division, U. S. Bureau of Mines. Mr. Emery will assume his new duties April 1 and have his office at the headquarters of the society in the Mills Building, Washington.

The **Cooley Electric Furnace Co.** announces the appointment of **L. M. Graham** as its sales director.

American Exchange Paper Before B.I.F.

The American Foundrymen's Association announces that its 1936 exchange paper for the Institute of British Foundrymen will be presented by Harold H. Judson, foundry superintendent, Gould's Pumps, Inc., Seneca Falls, N. Y. The Institute of British Foundrymen and the A.F.A., in 1921, initiated this annual exchange of papers. Originally started to present reviews on developments in foundry practice between Great Britain and the United States, this movement led to the formation of an International Foundry Committee, which is composed of representatives of foundry technical associations of the leading countries of the world, including, in addition to the United States and Great Britain, France, Italy, Belgium, Germany, Czechoslovakia, and Spain. Through this committee international foundry congresses are held every three years, the last one having been in Philadelphia in 1934. The next one is scheduled for Dusseldorf, Germany, in 1936.

Mr. Judson, who has been selected as the author for the 1936 I.B.F. paper, is well known for his developments in the production of high strength iron for large pressure pump castings, his paper on this subject before the 1932 convention of the A.F.A. being especially noteworthy. He also discussed shear tests for cast iron before the 1931 meeting of the American Society for Testing Materials.

Mr. Judson, born in Holyoke, Mass., is a graduate of Worcester Polytechnic Institute of the class of 1923, receiving a degree of B.S. in Mechanical Engineering. Following his graduation he was for three years foundry engineer with the Riley Stoker Co., Detroit. In 1926 he entered the employ of Gould's Pumps, Inc., as foundry superintendent, his present position.

Aluminum-Plated Cans for Beer

The Crown Cork & Seal Co., Baltimore, Md., has announced that it is prepared to supply aluminum-plated beer cans to the brewing industry. The proposed aluminum-plated container will use a conventional bottle cap at the opening, and will be double-coated with a layer of aluminum 0.0001 in. thick. The aluminum will be applied to the steel prior to fabrication into cans.

This company, which is a major producer of bottle tops, has found that aluminum foil in beer bottle tops has proved a good protection against acidic corrosion due to the ingredients in beer. The new aluminum can equipment being set up at the company's plant at Baltimore will have a capacity of 1,500,000 containers daily.

World's Largest Hot Mill Is Timken-Equipped

The 100-in. semi-continuous sheared plate mill being built for the Homestead Works of the Carnegie-Illinois Steel Corp. by the United Engineering & Foundry Co. will have Timken bearings on the back-up and work roll necks of five of the seven stands, two of the roughing stands being mounted on plain bearings. In addition to the roll neck bearings, Timken has been given the order for the bearings on the screwdowns, gear drives, table drives and accessory equipment.

The back-up roll neck bearings represent a new size, 31 x 48 x 33 in., each weighing 8,167 lbs. Work roll neck bearings will also be four row Timken units 24 x 14½ in. weighing 1030 lbs., and those on the finishing end being 18 x 23½ x 11 in. weighing 445 lbs.

A. J. Wadhams, manager of development and research, **The International Nickel Co., Inc.,** New York, has announced the addition of **Thomas N. Armstrong, Jr.,** to the technical staff. Mr. Armstrong, who will handle the steel castings development for the company, will operate out of the New York office. His services will be available to industry at large. Mr. Armstrong is well known in metallurgical circles as a result of various papers presented before the American Society for Metals and contributions to the technical press. He was formerly associate metallurgist at the Norfolk Navy Yard, Portsmouth, Va., and prior to that spent several years with the Andrews Steel Co., Newport, Ky., in open-hearth furnace work. He is a graduate of the University of Kentucky, with an M. E. degree.

Changes in Republic's Personnel

Paul R. Johnston has been named district sales manager for Republic Steel Corp., in the Cincinnati territory, succeeding Robert J. Working, recently appointed district sales manager at Birmingham, Ala.

Charles W. East, formerly of the Birmingham, Ala., office of Republic Steel Corp., has been named assistant manager of sales in Republic's pipe division, succeeding George E. Clifford recently appointed district sales manager for Republic in the Los Angeles, Calif., territory.

Robert J. Working has been apopinted district sales manager for Republic Steel Corp. in the Birmingham, Ala., territory, succeeding Kenneth D. Mann who has resigned to become executive vice president of Truscon Steel Co.

Monel Metal for New York's Buildings

Nearly 200,000 lbs. of monel metal have been ordered as roofing material for two of New York City's important buildings, according to an announcement by The International Nickel Co. The Pennsylvania Railroad is taking 30,000 lbs. of monel sheet to replace another type of sheet metal in the framework for the skylights above the main train shed and elsewhere on the Pennsylvania Station, a total area of approximately 85,000 sq. ft. When this terminal was built 25 yrs. ago, 300,000 lbs. of monel metal were used for roofing, flashing and penthouse siding, and periodic examinations have revealed no ill effects from exposure to the New York atmosphere. Six years ago some 25,000 monel metal bolts were used as replacement for bolts of another material in the skylight construction.

The second application involves 168,000 lbs. for the roof of the New York Public Library at Fifth Ave., and 42nd St. The decision to use monel metal, it is said, followed the examination of a sample which was placed in the roof more than 6 yrs. ago.

Vincent Delport Elected Vice Chairman of International Committee of Foundry Technical Associations

The American Foundrymen's Association has announced the election of its European representative, Vincent Delport, director and manager, Penton Publishing Co., Ltd., Caxton House, London, England, as vice chairman of the International Committee of Foundry Technical Associations. This is the organization which controls and schedules International Foundry Congresses, the next of which is scheduled for Dusseldorf, Germany, Sept. 15 to 20, 1936. Membership of the International Committee is composed of representatives of the foundry technical associations of the United States, Great Britain, France, Czechoslovakia, Germany, Holland, Italy, Poland and Spain. Mr. Delport has been A.F.A. representative on this committee for several years and this honor comes to him after distinguished services at various International Congresses.

During the past few months the **American Foundry Equipment Co.,** 555 Byrkit St., Mishawaka, Ind., has expanded its plant facilities and services. This has been brought about by the large increase in business caused by the demand for the American Wheelabrator—the airless abrasive cleaning equipment—as well as the other products of the company. Modernization of the entire plant, the addition of a large building for assembly and shipping facilities and the improvement of the foundry, as well as the expansion of the entire organization and the employment of considerably more labor, have been announced by Otto A. Pfaff, vice-president and general manager.

Radclyffe Furness, superintendent of the open-hearth and forge departments of the **Midvale Steel Co.,** died in January, at his home, "Open Hearth," Jenkintown, Pa., after an illness of six months. He was 67. He was educated at St. Paul's School, Concord, N. H., and Princeton University. Upon graduation from the latter institution in 1891, he went to work immediately in the open-hearth department of the Midvale Steel Co., and was recognized as one of the leading authorities on open-hearth practice.

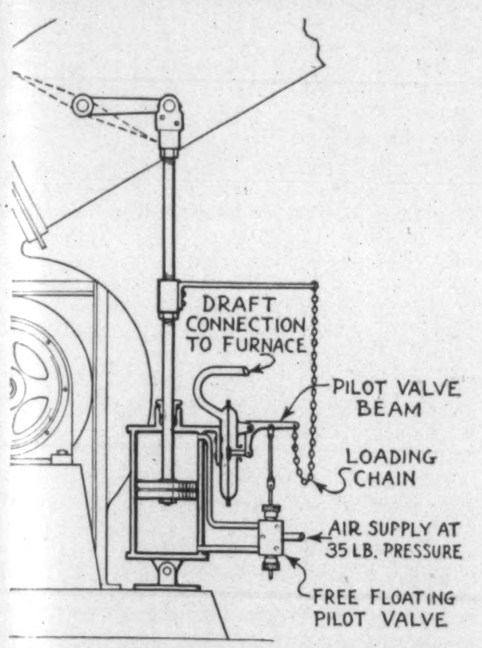
The Albra Castings Corp. is the name of a new organization located at Huntington, Ind. Its foundry is equipped to produce aluminum, brass, bronze, monel and other nonferrous castings. It was opened on January 15. The president is Herman Voges, Jr.

NEW EQUIPMENT AND MATERIALS

Draft Controller Functions Independently

A complete self-contained furnace draft controller requiring only a draft connection to the furnace and a supply of compressed air at approximately 35 lbs. pressure has been developed by Bailey Meter Co., Cleveland. This controller accurately measures furnace draft with a large sensitive diaphragm, the movement of which actuates an air pilot valve admitting pressure to one end or the other of a drive cylinder until the damper position or fan speed has been changed sufficiently to restore furnace draft to the desired value.

For example, in the diagrammatic illustration, an increase in furnace draft and a corresponding slight movement of the diaphragm to the left, moves the pilot stem downward, admitting pressure under the piston, which in turn moves upward and opens the damper. This movement diminishes the weight of chain supported by the pilot valve beam until the diaphragm force is exactly balanced and the pilot valve is returned to its neutral position. The chain loading device provides a simple and accurate means of applying a counter force against the diaphragm which is finely graduated with the movement of the control drive. When this counter force exactly balances the force produced by the furnace draft on the diaphragm, no further movement of the controller occurs.


DRAFT CONNECTION TO FURNACE
PILOT VALVE BEAM
LOADING CHAIN
AIR SUPPLY AT 35 LB. PRESSURE
FREE FLOATING PILOT VALVE

The Bailey draft controller may be applied either to the forced draft or the uptake draft as desired.

Alnico—A New, Powerful Magnet

Research in the field of permanent magnet alloys has resulted in a new alloy, "Alnico," so much more powerful than those commonly used hitherto as to open entirely new fields of application for permanent magnets, according to the General Electric Co. Small motors, and various control devices hitherto operated by electromagnets can now use permanent magnet fields, at a considerable saving in cost and greater simplicity of construction; and Alnico already has been used by General Electric in a variety of applications. Alnico magnets will lift about 60 times their own weight, when designed for that purpose.

The new alloy is usually a cast material and is finished to shape by grinding. The Simonds Saw & Steel Co., Lockport, N. Y., has been licensed by General Electric to manufacture and sell magnets of the new alloy.

An alloy consisting of the ingredients present in Alnico was originally developed by the General Electric Co. as a heat-resisting alloy which resists scaling and deterioration at high temperatures. Some work on the magnetic properties of alloys of this type were later carried out by Prof. T. Mishima of the Imperial University, Tokyo. General Electric has perfected a process of heat treating the alloy by which its magnetic properties are fully developed.

Only a few years ago an alloy of iron, aluminum, and nickel was discovered to possess suitable permanent-magnet properties. This alloy contains no carbon and belongs to the precipitation-hardening type of alloys, quite distinct from the steels. The addition of cobalt was the next step; and thus was born Alnico. With the discovery that a precipitation-hardening alloy may possess excellent permanent-magnet properties, an entirely new field of alloys for magnets was opened for research.

The coercive force is higher and the residual induction lower for Alnico than for other magnetic materials. Alnico magnets are less subject to demagnetization by stray fields. They are less subject to demagnetization by high temperatures, and also to demagnetization by mechanical vibration. These magnets require a considerably stronger magnetizing force to magnetize them completely than do other magnet materials.

The new magnet alloy has a relatively low specific gravity (6.9), is non-corrosive, and is brittle. It is cast in the proper design, and finished by grinding.

New Alloy for Making Molds for Plastics

In its January issue, Bakelite Review, published by the Bakelite Corp., New York, describes the increased opportunities afforded plastics due to the recent development of cast beryllium-copper molds. This development is the result of two years of carefully planned experimental work carried on by the Bronze Division of the Gorham Co., silversmiths.

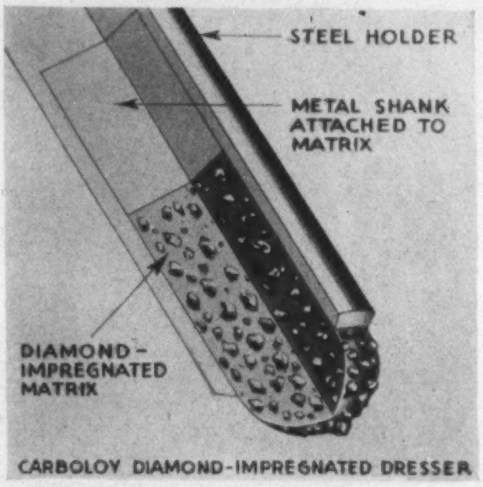
Difficulties encountered in producing tool steel molds and pack hardened steel molds are responsible for the high cost of molding dies, says the Review. It is pointed out, however, that beryllium-copper should be considered supplementary to the mold materials now employed and not a panacea or cure-all. The plastic industry should consider cast beryllium-copper as a new tool. Like all new tools, it will be some time before its true place in the industry will be determined.

Among other details the article explains the suitability of beryllium-copper for cast molds, the type of molded pieces for which these molds can be employed to greatest advantage, the mechanical properties of beryllium-copper, and its apparent present limitations.

In referring to the types of cast beryllium-copper molds which can be produced economically, the following are emphasized: (1) For small parts of intricate design where the hob would be too fragile to stand up in the reproduction of cavities in mild machine steel, and (2) for decorative ornamental designs where reproduction is obtainable in steel only by expensive hand engraving.

Carboloy Announces New Wheel Dresser

Carboloy Co., Inc., Detroit, manufacturers of Carboloy cemented carbide products, announce the release of an additional grade of its diamond impregnated wheel dresser. The new grade contains an extra coarse mesh of diamonds and has been developed to increase the order of performance on the larger and harder grades of grinding wheels used on surface, cylindrical and centerless grinders. This extra coarse grade supplements the existing grades of Carboloy dressers containing fine, medium and coarse mesh size diamonds. With this development, the Carboloy dresser can now be used on all hardnesses and sizes of grinding wheels.



CARBOLOY DIAMOND-IMPREGNATED DRESSER

Advantages of the Carboloy diamond impregnated wheel dresser, as described by the manufacturer, are that no remountings are required, they stand unusual abuse, and each dresser may be used throughout its entire life on the same sized wheel.

New Development in Seamless Alloy Tubes

The Babcock & Wilcox Tube Co., Beaver Falls, Pa., announces the commercial production of seamless tubes and pipe of a highly alloyed steel containing 25 per cent chromium and 20 per cent nickel. These products are available hot-finished in sizes up to 6 in. outside diameter and cold-drawn in smaller sizes. The company extends its range of analyses with this new alloy, which is being marketed under the trade name "B. & W. Croloy 25-20."

This alloy has a high degree of oxidation resistance and is suitable for continuous operation at temperatures up to approximately 2100 deg. F. It is a ductile material possessing greater creep strength and resistance to oxidation at high temperatures than is possessed by alloys now commercially available in the form of seamless tubing. Its properties are such that the alloy will undoubtedly find a field of usefulness in high temperature cracking, polymerization and other refinery operations, as well as for high temperature equipment such as recuperators, thermocouple protection tubes, valves, and heat-resistant tubular members.

This alloy has been available for high temperature application in sheet, plate, rods, and castings, but has not, heretofore, been made available in seamless tube form except through a tedious forging and boring process.

Rust Preventatives

"Penlaco Rust Preventives," manufactured by Penola, Inc., and marketed by the Esso Marketers, are currently being introduced throughout the eastern states, according to an announcement by the Standard Oil Co. of N. J., one of the group of companies comprising the Esso Marketers. The other companies in this group are the Standard Oil companies of Pennsylvania and Louisiana and the Colonial Beacon Oil Co., Inc.

Penlaco Rust Preventives are protective, varnish-like compounds which are spread on metal surfaces by wiping, brushing, dipping or spraying. They dry to a hard film, which is impervious to water and capable of sealing the surface from air, thus effecting a long-time protection of metal against rust. These preventives are available in a variety of grades, ranging from a thin, fast-drying product to a heavy, general-purpose grade. No other rust preventive or paints need be used with them.

These new preventives are a combination of a volatile solvent with a non-volatile portion. Skillful processing, blending and controlling of the long oil spar-varnish in the non-volatile base imparts outstanding adaptability and service characteristics. Penlaco Rust Preventives are designed primarily for use where a dry, durable, non-removable, protective coating which is transparent and water resistant, is desired.

New Heavy Duty Floorsteel

Used by a large number of industrial concerns for plant floor armoring, "Acme Heavy Duty Floorsteel" is providing a long-wearing, non-skid floor surface that is particularly low in annual cost. It is made by the Acme Steel Co., Chicago. The new construction consists of a network of small mesh, (1¼ x 1¼ in.) made of heavier sections of rolled steel than were formerly used. This reinforcement may be used for either new or old floors; over concrete, brick, wood, or any other surface. It is laid flush with finished floor line, and filled with concrete or asphalt mastic, whichever material is best for conditions encountered.

Acme Heavy Duty Floorsteel comes in one-piece rolls containing 100 sq. ft. or more. Installation is quick and easy because these large sections are simply rolled out like rugs and joined together with steel pins inserted 3 to the lineal foot. Fitting around posts or other obstructions is easily done by cutting Floorsteel to fit, with special snips. Anchors are used to fasten the mesh where used over wood sub floors.

The advantages claimed for this industrial floor surfacing material include: A quiet, non-skid floor surface; the exposed edges of the steel mesh bear the load like rails; cracks, holes, and ruts cannot develop; the flooring is permanently smooth and even; maintenance costs are practically eliminated.

Motors for Steel

In the most recently accepted process for producing thin flat rolled stock, heated steel slabs, 3 to 6 in. thick and weighing several tons, are first rolled at high speed in a heavy continuous hot mill to strip, usually less than 0.11 in. thick, which is coiled as it leaves the mill while still hot. Delivery speeds up to 2000 ft. per min., are proposed for hot strip mills now under construction. After being pickled to remove oxide formed during rolling, the coils of hot rolled strip, several hundred feet long, are reduced to sheet or tinplate gages by cold rolling at speeds ranging from 500 to 1200 ft. per min. The finished coil, 5000 to 10,000 ft. long, annealed or normalized, is cut to desired lengths by automatic shears, ready for shipment or further processing such as galvanizing or tinning.

A modern hot strip mill usually consists of 10 main roll stands arranged in tandem. Four are roughing stands, separated so that metal is in only one stand at a time. The roughing stands are usually driven at constant speed by induction motors of 2500 to 5000 hp. capacity. The six finishing stands are mounted as close together as possible and each stand is driven by a 600-v. adjustable speed direct current motor, ranging in capacity from 2500 to 5000 hp. Power for the finishing train is supplied by two or more synchronous motor-generators of 4000 to 6000 kw. capacity each. The complete installation will occupy a building 1000 ft. long and 100 ft. wide. About once every minute a steel slab of several hundred tons weight passes in a straight line through the mill. With the passing of each piece of steel through the mill, the electrical input to the motor room will rise from a few thousand kilowatts to a peak of 15,000 to 30,000 kw., depending on the width of the finished strip. The illustration shows two of five 3000 hp. motors furnished by Westinghouse Electric & Mfg. Co., Pittsburgh, for driving the finishing train for a 56-in. hot strip mill.

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LOW-CARBON STEEL
outwears expensive tool steels

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With Chapmanizing—the modern surface-hardening process—you can make parts of low-cost low-carbon steel instead of expensive tool steels . . . Chapmanize them . . . *and get an actual increase in wear resistance.*

Chapmanizing gives these low-carbon steel parts a tough, ductile case that outwears a carburized case nine-to-one. It produces in 2 hours a case as hard as nitriding produces in 30 hours. It is faster than carburizing, cyaniding.

It hardens any low-carbon steel to 1000 Brinell (86 Rockwell "A", 65 Rockwell "C", 90 Scleroscope) . . . produces a case of any required depth between .002″ and .035″.

It costs less than ordinary case hardening, requires no capital investment.

The coupon will bring a copy of the Chapmanizing Handbook — without obligation. Mail it today.

Compare these typical wear-test results. Chart shows loss of weight in .01 grams per sq. inch—30,000 strokes, metal to metal, dry.

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Hard-Face Can Top Die

The die, herewith illustrated, forms can tops from steel sheet at one of the large can manufacturing plants. The cutting edge is protected by a welded-on layer of nonferrous hardfacing alloy. The hard-faced dies last four times longer than former dies, according to the Haynes Stellite Co., 30 East 42nd St., New York.

World's Largest Plating Tank

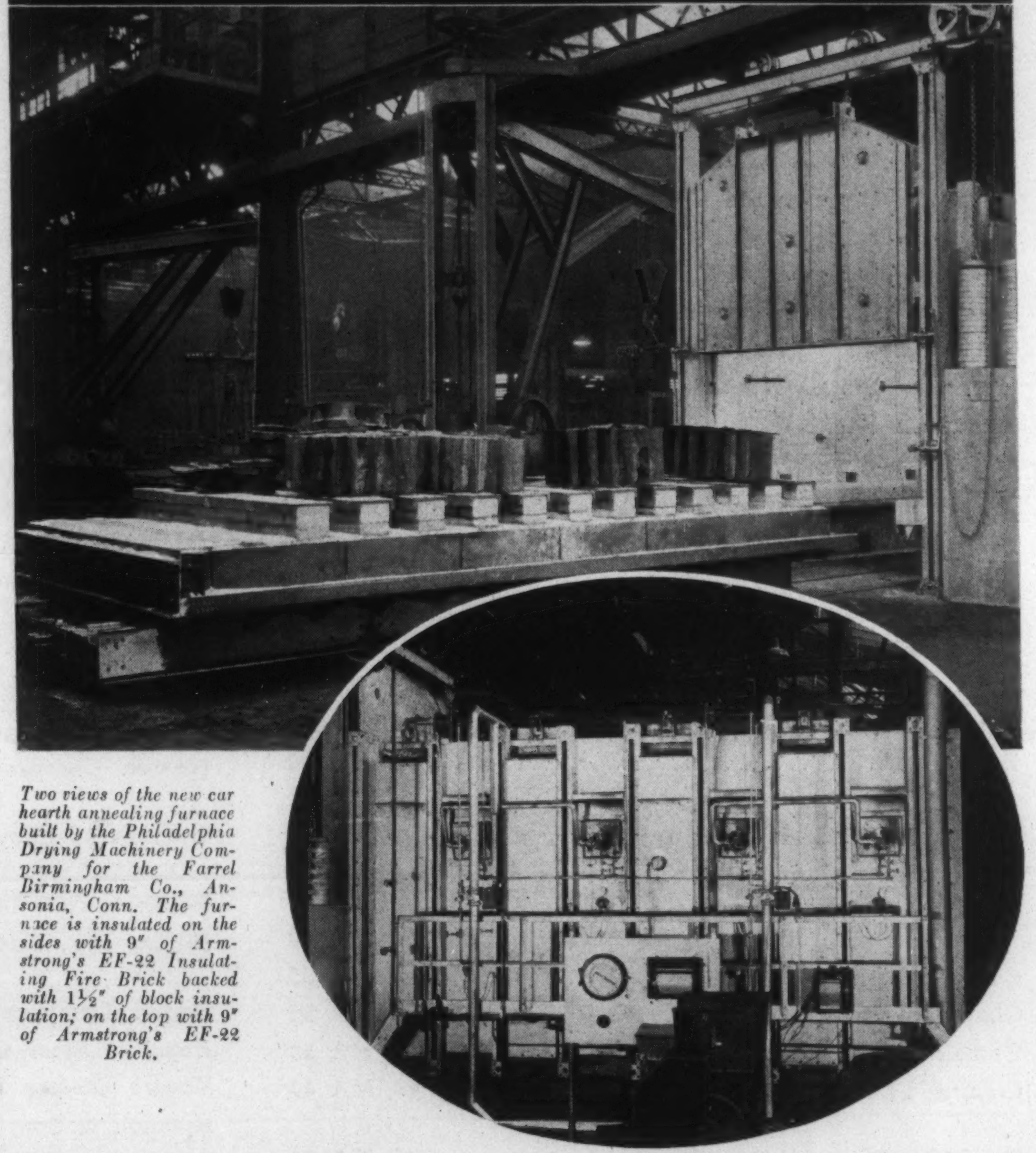
The second of two electroplating tanks, stated to be the largest of their kind ever built, has been recently designed and built by Gross Engineering Corp., 2163 West 105th St., Cleveland, for an Evansville, Ind., firm. This tank is to be used in connection with the "alumilite" process of producing colored finishes on large aluminum automobile body stampings without the aid of paint or varnish. It is 38 ft. long, 6 ft. 6 in. wide and 4 ft. 6 in. deep. In order to maintain the alumilite solution at the proper temperature, a double-bottomed water-jacket containing 800 ft. of lead steam piping is provided between inner and outer shells. All parts exposed to the corroding effect of the solution are either lead or lead-coated by the Gross "leadhesion" process. The outer tank is of lead-coated steel plates and the inner one is of heavy-gage lead sheets, supported by strong wire mesh. The fume-removal system consists of a slotted hood surrounding the upper part of the tank just at the solution level; thus drawing off the vapor as soon as formed. The total weight of the tank, empty, is 16 tons.

New Type of Respirator

A new type respirator with approved high efficiency, having passed the U. S. Bureau of Mines test for lead and Type A dusts, has recently been offered by Wilson Products, Inc., Reading, Pa. It has a filter bag through which breathing very close to normal is assured. This because of very large filtering area of 40 sq. in. The face mask is made of rubber and is adjustable to any shape of face by bending a wire forming spring which constitutes a part of the lower mask edge. The filter bag is assembled on the mask by means of a screw ring inside of which is the intake valve assembly including moisture baffle, serrations to prevent air lock and a flexible intake diaphragm. Air is drawn in through the filter bag at the front and exhausted through the valve assembly below the face mask. Filter disc replacement problem is satisfactorily solved by the use of this cleanable bag type filter which in most cases lasts as long as the respirator itself. The complete respirator weighs only 5¼ oz.

Multiple Heat Control

PERMITS GREATER EFFICIENCY AT LOWER COST IN THIS NEW CAR HEARTH FURNACE



Two views of the new car hearth annealing furnace built by the Philadelphia Drying Machinery Company for the Farrel Birmingham Co., Ansonia, Conn. The furnace is insulated on the sides with 9" of Armstrong's EF-22 Insulating Fire Brick backed with 1½" of block insulation; on the top with 9" of Armstrong's EF-22 Brick.

THIS car hearth annealing furnace, built by the Philadelphia Drying Machinery Company, offers a new "high" for economy in the construction and operation of this type furnace.

Multiple small burners permit accurate zone control of temperatures. Armstrong's EF-22 Insulating Fire Brick construction gives maximum heat reflection.

The elimination of a refractory lining made possible thinner walls —lighter steel and less brick work. The high insulating qualities of this brick provide a sharper, quicker furnace; more uniform temperature throughout the furnace; lower fuel costs; and low heat storage.

Armstrong's EF-22 Insulating Fire Brick is designed for direct exposure up to 2200° F., EF-26 for similar use up to 2600° F. Insulating bricks in the Armstrong Line are: N-16 for temperatures up to 1600° F. behind the refractory; N-20 for temperatures up to 2000° F. behind the refractory; and A-25 for temperatures up to 2500° F. behind the refractory.

For concise facts get new folder "Armstrong's High Temperature Insulation . . ." Armstrong Cork Products Co., Building Materials Division, 982 Concord St., Lancaster, Penna.

Armstrong's

HIGH TEMPERATURE INSULATION

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Where weight and expense are partners

It is estimated that reducing the empty weight of a railroad car one ton means an annual operating saving of $17.97 per car.

The high weight—strength ratio of the Moly steels used in car construction permits an average reduction of 4.5 tons per car. Result—$89.85 annual savings per car!

That is vitally important itself. But—Moly steels are also exceptionally well fitted to withstand the terrific manhandling, abuse, and corrosion that is the ordinary lot of rolling stock. Lower operating costs plus longer service permits greater profits.

Your problems may be—probably are—different. They may involve creep strength or fatigue strength, or temper brittleness, or just plain fabricating economy. Whatever they are, it will pay you to investigate Molybdenum.

The wide experience of the engineers in our experimental laboratories is at your disposal. Our technical book, *"Molybdenum"* and our news-sheet, *"The Moly Matrix"* will be sent on request. Climax Molybdenum Company, 500 Fifth Avenue, New York, N. Y.

CUTS COSTS MOLY Climax Mo-lyb-den-um CREATES SALES

1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Recovering Zinc and Vanadium at the Rhodesia Broken Hill Plant. T. R. Pickard. *Engineering & Mining Journal*, Vol. 136, Oct. 1935, pages 489-493. Concentration, acid leaching and electrolysis are employed at this plant. Flowsheets are given for gravity concentration of V ore, for leaching of V concentrates, for Cu and P, for removal of Cu and P, and for Zn ore leaching. Al cathodes are employed, the Zn is stripped by native laborers, piled on cars and taken to the furnace room. WHB (1)

Southern Gold at Hog Mountain. N. O. Johnson. *Engineering & Mining Journal*, Vol. 136, Oct. 1935, pages 505-510. Progress in mining and milling with standard methods at the leading enterprise in the Appalachian Mountains is indicated. Recovery and increase in mill capacity are expected upon completion of the installation of finer crushing equipment and the production of a low-grade primary concentrate (10:1 ratio of concentration) which will be reground and refloated in a separate ball mill and flotation circuit. A cyanide plant will be installed later. WHB (1)

1c. Flotation

Lead-Zinc Ore from the Stirling Mine, Stirling, N. S. W. B. Timm *et al.* *Canada Department of Mines, Mines Branch Report* No. 747, 1935, pages 79-106. Talc can be removed by flotation at any convenient point in the grinding circuit. Fine grinding is necessary to free the sulphides from each other. A bulk Cu-Pb concentrate is floated. Galena floats more slowly than usual; floatability is increased by cyanide. Chalcopyrite is more sensitive to cyanide than usual. A Zn concentrate is made easily. **Copper-Nickel Ore from the Cuniptau Mines, Goward, Ontario.** Pages 107-110. This ore is difficult to concentrate; it is too fine grained to use gravity concentration. In flotation, serpentine gangue floats with the sulphides. Some of the talc serpentine was first floated off, then the use of glue (½ lb. per ton) prevented the rest from floating with the Cu and Ni (reagents: amyl xanthate and pine oil). AHE (1c)

New Flotation Plant of B. H. South, Ltd. *Chemical Engineering & Mining Review*, Vol. 27, Sept. 9, 1935, pages 432-433. A new Pb and Zn flotation section has just been completed at the plant of the Broken Hill South, Ltd. Cross- and longitudinal-sections of the plant are shown and operating costs and power consumption in kw. hr./ton of crude ore treated indicated in a table. Increase in Pb flotation concentrates have increased from 72.5 to 73.4 and in Zn concentrates from 52.7 to 53.2. WHB (1c)

Statistical Microscopic Study of Ores and Mill Products from the Anyox Plant of the Granby Consolidated Mining, Smelting & Power Co., Ltd., Anyox, British Columbia. R. E. Head, Arthur L. Crawford, F. E. Thackwell & A. Lee Christensen. *United States Bureau of Mines Report of Investigations* No. 3290, Oct. 1935, 18 pages. Except for an insignificant amount of covellite, the entire Cu content is present as chalcopyrite. Association of the Cu and Fe minerals is very close. The ore is ground to liberate most of the Cu and to free the rest from gangue and large particles of Fe sulphides capable of being floated in a low-grade concentrate that is reground and refloated. An alkalinity of 0.11 lb. CaO/ton of solution is maintained in the primary cells and 0.02 lb. in the regrind. Reagent consumption is neutral creosote oil 0.16, K et xanthate 0.05, pine oil 0.06, hydrated lime 2.00, NaCN 0.023 lb./ton of ore. The flow sheet is given. The best concentrate is made at 150 mesh; in sizes smaller than 150 mesh free pyrite and pyrrhotite float in increasing quantities. Greater difficulty is experienced in rejecting pyrrhotite than pyrite. Magnetite rejection is fairly good and open to little improvement since 50% is locked with chalcopyrite. Locked chalcopyrite is negligible at —400 mesh. In the tails 54.9% of the chalcopyrite is free. Data are given showing the amount of pyrite, pyrrhotite, magnetite and chalcopyrite in each size of the classifier overflow, in the primary Sub-A concentrate, in the middling feed, in primary middling, in middling concentrate, in the scavenger concentrate, in primary Sub-A tails, in middling tails, and in general tails. AHE (1c)

1e. Amalgamation, Cyanidation & Leaching

Stamp-milling and Amalgamation Practice at Goldenville, N. S. E. H. Henderson. *Transactions Canadian Institute of Mining & Metallurgy*, 1935 (in *Canadian Mining & Metallurgical Bulletin* No. 283, Nov. 1935) pages 473-474. Discussion. See *Metals & Alloys*, Vol. 6, Nov. 1935, page MA 434R/7. AHE (1e)

Gold Ore from the Dufferin Mine, Nova Scotia. W. B. Timm *et al.* *Canada Department of Mines, Mines Branch Report* No. 747, 1935, pages 28-29. Amalgamation of —48 mesh ore gives 79% extraction of the Au; cyanidation recovers 99.5% of the Au. AHE (1e)

Milling Practice for Small Gold Mines. C. S. Parsons. *Transactions Canadian Institute of Mining & Metallurgy*, 1935 (in *Canadian Mining & Metallurgical Bulletin* No. 282, Oct.) pages 437-464. There are 3 types of Au mills commonly used at small mines: (1) amalgamation and gravity concentration, (2) amalgamation and flotation, and (3) cyanidation. Costs of a small mill will be $600-$3,000/ton of ore treated per day. Operating costs (without taxes, depletion or depreciation) are $7-$12. The general design and layout of small mills is discussed in detail. The flow sheets of 8 small mills are given and discussed. AHE (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

2a. Non-Ferrous

Treatment of Impurities in the Production of Electrolytic Zinc. Werner Froehlich. *Metal Industry*, London, Vol. 46, Apr. 12, 1935, pages 403-406. After indicating the commercial procedure used in the production of electrolytic Zn and outlining the single-leaching and double-leaching processes, the author discusses the limiting amounts of the impurities As, Sb, Fe, Si, Al, Ni, Co, Mn, Cu, Cl, and Cd that may be present in the electrolyte, either singly or in conjunction with other impurities, without having a detrimental influence; methods for their removal from the electrolyte; and a rapid method of analysis. A method of treatment of the Zn residue is also indicated. HBG (2a)

Sintering Tests on Flotation Concentrate from the Beattie Mine, Duparquet Township, Abitibi County, Quebec. W. B. Timm *et al.* *Canada Department of Mines, Mines Branch Report* No. 747, 1935, pages 148-151. The sintering of flotation concentrate from the Beattie mine without the admixture of coarse material is possible though difficult. In practice, the inclusion of "returns" and Cu concentrate makes sintering easy. AHE (2a)

Copper Precipitation. Arthur J. Caddick. *Metal Industry*, London, Vol. 46, Feb. 22, 1935, pages 213-215. Author outlines results of investigations using a revolving barrel as container for the Fe precipitant used for the recovery of Cu from mine waters and liquors obtained by leaching cuprous minerals and residues. Barrels have been proved successful for liquors of high Cu content and it was to investigate the possibilities with low Cu liquors that these tests were made. Large scale tests were made in an Fe pipe 25" in dia. x 6', fitted on rollers. The charge used, speed and time required are reported. The results obtained indicated that while this method has many advantages when treating Cu-rich liquors, the tank process is more economical for the liquors with a low Cu content. HBG (2a)

New Methods for the Utilization of Copper, Gold, and Silver Ores Containing Arsenic (Neue Wege zur Verarbeitung von arsenhaltigen Kupfer-, Gold-und Silbererzen). Carl Goetz. *Metall und Erz*, Vol. 32, Sept. 1935, pages 405-410. Laboratory experiments were first made on heating AsFeS with and without the addition of Fe_2O_3 in N_2, CO and CO_2 at 600° to 900° C. The volatilization of S and As was lowered by Fe_2O_3 addition and that of As was lowest in CO_2. When Cu_2S, AsFeS and Fe_2O_2 mixtures were heated at 600° to 900° in N_2 and illuminating gas, metallic Cu, magnetic pyrites and FeAs were formed. In similar experiments with Au and Ag ores metallic Au and Ag were formed. Tests on the magnetic purification of the same ores were also made. CEM (2a)

Preparation of Pure Gallium. James I. Hoffman. *Electrometallurgy*, supplement to *Metal Industry*, London, Vol. 46, Mar. 22, 1935, pages 335-336; Apr. 5, 1935, pages 391-392. See *Metals & Alloys*, Vol. 6, May 1935, page MA 178L/2. HBG (2a)

Production of Titanium-Aluminum Alloys in Electrolytic Cells. A. I. Zheleznov & B. N. Maksimenko. *Legkie Metallui*, Vol. 4, Apr. 1935, pages 24-42. In Russian. TiO_2 and Al_2O_3 were electrolyzed to produce alloys containing up to 1.53% Ti. During the test run, about 3800 kg. of alloy were obtained with an average daily output of 141.3 kg./cell and a current efficiency of 73.5%. Some segration of Ti occurred due to the large difference in sp. gr. of Al and Ti. This can be prevented by frequent stirring. In other respects, electrolysis proceeded normally. HWR (2a)

Proper Composition of the Charge in Smelting of Calcium Aluminate Slags. G. K. Margashak. *Legkie Metallui*, Vol. 4, Apr. 1935, pages 3-8. In Russian. In the production of Ca aluminate slags by fusing $CaCO_3$ with bauxite, the maximum extraction of Al_2O_3, about 80%, is obtained when the molecular ratio $CaO:Al_2O_3$ in the slag is 1.18-1.27. The presence of SiO_2 in the slag does not change this ratio. HWR (2a)

2b. Ferrous

Sintering Adds Greatly to Efficiency of Ironton (Utah) Plant, Columbia Steel Co. George D. Ramsay. *Mining & Metallurgy*, Vol. 16, Sept. 1935, pages 365-368. Ore crushed through a 4" screen produced about 314 tons of basic Fe/day with a coke consumption of 2457 lbs./ton of Fe. To effect fuel economies ore was crushed through 3" screen. The tonnage increased to 376 tons of Fe with coke consumption of 2122 lbs./ton of Fe. Crushing to 2" and screening into 3 sizes gave 396 tons of Fe with 2024 lb. of coke/ton of metal. Further experiments showed that size should be reduced as follows: Coarse ore through 2¼" and on 1¼", medium ore through 1¼" and on ⅜" and fine ore —⅜". Includes table giving analyses, screen tests and unit wts. of ores. VSP (2b)

Ferro Alloys Used in Alloy Steels (Ferrolegierungen als Zusätze zu Edelstählen). Kärsten. *Chemiker-Zeitung*, Vol. 59, July 10, 1935, pages 556-557. Ferro Mn and ferro Si are used both for deoxidation and alloying. Ferro Mn is usually made in a blast furnace, and most other ferro alloys in an electric furnace, on account of the high heat required. For ferro Si, 3000 to 10,000 kw. furnaces are used, smaller ones for other alloys. The charge consists of quartzite, coke and scrap. The higher the Si content the more kw.-hr. are required. In the case of ferro Cr, ferro W, and ferro Mo the charges are first pressed together to lower the loss. In some cases electric filters are used to recover the dust. Ferro Cr usually contains 60-70% Cr and 0.50% or more C. By remelting and adding more ore the C can be lowered to 0.2 or 0.15%. C-free ferro Cr is made by reducing with Si instead of coke and removing the resulting SiO_2 with CaO. Ferro W and ferro Mo do not melt and must be lifted out of the furnace instead of being poured. CEM (2b)

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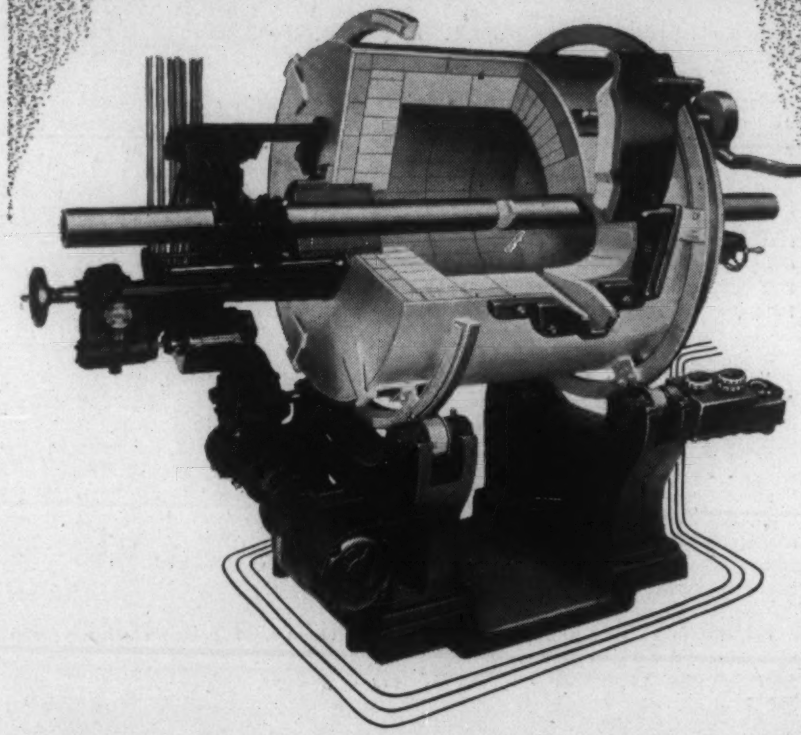

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3. MELTING, REFINING AND CASTING

Is a Mechanized Foundry Worth While? L. J. TIBBENHAM. *Foundry Trade Journal,* Vol. 53, Oct. 31, 1935, pages 328-330. A paper read before a joint meeting of the London and East Midlands branches of the Institute of British Foundrymen. Cost advantages and disadvantages of mechanization are discussed. AIK (3)

Gates, Risers, and Overflows, Their Correct Application to Obtain Good Castings (Eingüsse, Steiger und Ueberköpfe, ihre zweckmässige Anwendung zur Erzielung guter Gusswaren). F. PASCHKE. *Giesserei,* Vol. 22, Oct. 25, 1935, pages 539-542. Methods of correct molding for economical use of material are discussed and illustrated. Ha (3)

American Foundry Industry (Aus der Amerikanischen Giessereiindustrie). E. PIWOWARSKY. *Giesserei,* Vol. 22, Oct. 25, 1935, pages 536-539; Nov. 8, 1935, pages 561-565. A number of ferrous and non-ferrous American foundries are described and compared with those in Germany. Ha (3)

Gases in Metals. C. A. EDWARDS. *Transactions American Institute Mining & Metallurgical Engineers, Institute of Metals Division,* Vol. 117, 1935, pages 13-38. Institute of Metals Division Lecture, presented Feb. 1935. The behavior of gases in both ferrous and non-ferrous metals and alloys is discussed. Rimming steel is then discussed in some detail and some of the author's results on small ingots containing different amounts of C and O are given. There were 3 series of ingots containing respectively 0.02, 0.12, and 0.20% C. The effective O content of individual ingots in each series was varied by adding a constant amount of O to each heat and then adding a variable quantity of Al. Photographs of the sectioned ingots show that all types of ingots produced in commercial practice were produced in the experiments. 15 references. JLG (3)

The Morris Foundry at Coventry. *Engineering,* Vol. 140, Oct. 4, 1935, pages 376-378. Illustrated article describing the plant lay-out of the foundry of Messrs. Morris Motors, Limited. The factory is designed to deal with every stage in the manufacture of certain automobile parts from the reception of the raw materials to the production of a completely machined unit. LFM (3)

Automatic Mold Elevator and Conveyor Unit Offers Marked Economies. *Iron Age,* Vol. 136, Aug. 22, 1935, pages 20-21. Describes automatic mold elevator and conveyor units that can be constructed in horizontal area and in height to conform to existing foundry structures and which afford economies of floor space, man-hours, and human fatigue. Units are made by Link-Belt Co., Chicago. VSP (3)

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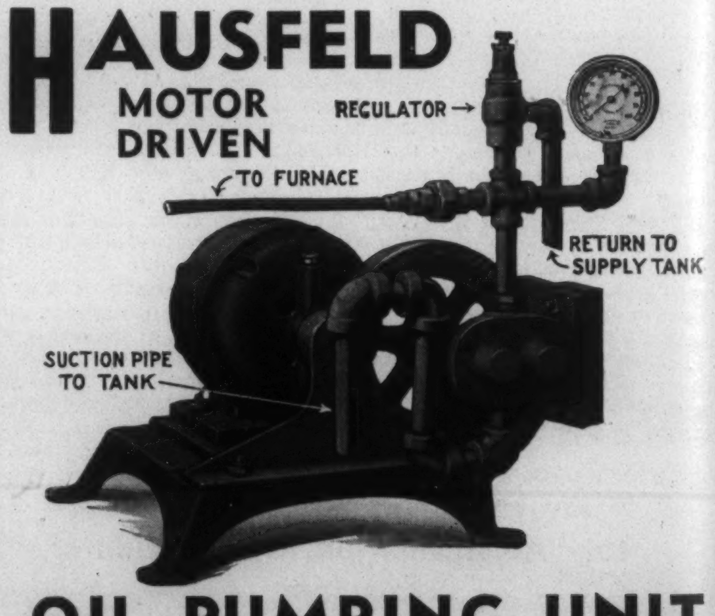

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The Metal Casting Industry. H. L. Campbell. *Metals & Alloys,* Vol. 6, Aug. 1935, pages 209-211. General discussion of common problems encountered in the average foundry. WLC (3)

Strickle Moulding of Large Castings. H. Fabre & H. Dubois. *Mechanical World & Engineering Record,* Vol. 48, July 26, 1935, pages 75-76, 80. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 482R/4. WH (3)

3a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

The Remelting and Refining of Scrap Nickel. Edmund R. Thews. *Metal Industry,* London, Vol. 46, Mar. 8, 1935, pages 265-268. Major metallurgical difference between scrap Ni and scrap of other common metals and alloys is that, theoretically, the refining of Ni-scrap is very simple, but in practical operation it is quite different. This is attributed to the high melting point of Ni and to the great affinity for Ni of S, O, and particularly CO of the gases of combustion. The capacity of Ni for absorption of gases is one of the chief difficulties encountered in refining scrap-Ni. The chief solid impurities are S, C, and Si, with S the most potent embrittling agent. That brittleness may be due to the presence of Ni oxide has been proven by treatment with Mg, Mn, and C, all strong deoxidizing agents. Mg was the only one of the 3 used during remelting and refining that entirely removed this brittleness. Other common impurities are As, Si, Pb, Zn and Fe, with As the only one that would seriously affect the mechanical properties of the Ni. However, due to the high operating temperature and the oxidizing process initiating the refining process, the As is completely oxidized and removed. Co, which is generally present in commercial Ni, has no influence on the physical properties of Ni unless it is present in excessive amounts. It is essential that, in melting and refining scrap Ni, the molten metal must be protected from gases and that only fuel of low S be used. Reverberatory and crucible furnaces as well as the electric furnaces are used. For large quantities of scrap best results have been obtained with the reverberatory furnace under normal smelting conditions. Obviously the electric furnace offers the most favorable conditions to protect molten Ni from gas absorption although fuel fired furnaces can be used satisfactorily with normal slag conditions. Basic linings are necessary due to the affinity of Ni for Si. In the description of the melting process, the necessity for preheating and "soaking" the furnace prior to charging is pointed out. 3 methods of oxidation are considered and their disadvantages indicated. Pb is considered the most difficult impurity to remove and may require a considerable increase in the length of the oxidation period. The presence of Zn hastens the elimination of Pb. After the completion of the oxidation period, the surface is cleaned of impurities and the Mg added to remove the S. A method of testing to determine the amount of Mg required to remove brittleness is outlined. Several types of furnaces are discussed. HBG (3a)

The Remelting of Scrap Aluminum. Harold Silman. *Metal Industry,* London, Vol. 46, June 21, 1935, pages 667-668. In the economical disposal of the turnings, etc., produced in the manufacture of Al products there are a number of factors that must be considered. Among these are: (1) the necessity for distinguishing between the different types of waste Al, (2) the advantage of cleaning scrap before remelting, (3) melting practice and (4) the proper use of fluxes. The newer refining methods that utilize Cl or BCl_3 are compared with the older methods in which the metal is held molten for 24 hours. HBG (3a)

Silver in the Foundry. E. A. Smith. *Foundry Trade Journal,* Vol. 53, Sept. 12, 1935, page 194. Ag when pure is by no means an easy metal to cast it being difficult to obtain castings which are sound and free from sponginess. In the molten state Ag absorbs large quantities of O_2; and just above its melting point of 961° C. will absorb as much as 20 times its own volume of this gas. Practically all the O_2 is liberated during the subsequent solidification of the metal, resulting in a "spit" which covers the whole of the exposed surface of the bar cast in an open mold. The effect of this on the Ag is to cause sponginess and a certain amount of brittleness which renders pure Ag in the cast state useless for industrial purposes unless proper precautions are taken to remove the O_2. In modern Ag foundry practice this is usually overcome both in the case of pure Ag and the alloyed metal by the use of deoxidants, such as Cd, Zn, or Cu phosphide. Close attention must be given to the melting and teeming temperatures, in order to prevent a spongy cast and it is essential that the molten metal be protected from oxidation by a suitable covering of charcoal or of borax or other flux, which is skimmed off before casting. AIK (3a)

Recent Advances in the Founding of Aluminum Alloys. I. G. Slater. *Metal Industry,* London, Vol. 46, Apr. 5, 1935, pages 379-382; Apr. 12, 1935, pages 415-418; Apr. 19, 1935, pages 433-436. Paper read before the Institute of British Foundrymen (London Section) on Mar. 13, 1935. As is indicated by the title the author has endeavored to summarize the portion of the voluminous published information that deals with the founding of Al alloys. He discusses (1) developments, (2) melting practice, (3) casting technique, and (4) relationship between dimensions of a casting and its properties. Under (1) the development in the manufacture of Al of very high purity is considered the most striking advance, particularly from the standpoint of the consumer. It is now possible to obtain virgin Al of a purity of 99.9%. The multiplicity of alloys of Al, now well over 200 in number, is pointed out with the suggestion that rationalization is needed. Another is the development of alloy-compositions amenable to heat-treatment which has done so much to extend the usefulness of Al alloys. Among the alloys discussed are the Si-Al and Al-Mg alloys. The effect of impurities and the influence of additions of Ti, Ce, Cu and Mn are considered. The properties of a number of alloys of these types are listed. Under (2) are discussed (a) liability of gas absorption, (b) formation of Al oxide, and (c) contamination by impurities derived from melting equipment. Sources responsible for gas absorption are listed as type of furnace and furnace fuel employed, the relative humidity of the air, time and temperature of contact between products of combustion and the permeability of the melting vessel to gases. In considering the types of melting equipment, the author includes electric, coke-fired, oil and gas-fired furnaces. The effect of quality of the ingot is discussed as a possible source of gas-absorption. Methods for the removal of gases outlined are (a) pre-solidification, (b) treatment with N, (c) treatment with Cl, (d) treatment with other halogens, (e) maintenance of the melt just above the melting point for an interval of time in an electric furnace, (f) the use of fluxes, and (g) treatment with volatile chlorides. The development of casting technique (3) is a result of careful studies of the factors influencing the metal from the time it leaves the melting vessel until it is at room temperature in the casting itself. These include studies of casting temperature, speed of pouring, dimensional changes on solidification, feeding, mold condition, mold materials and dressings. In discussion of (4), relationship between dimensions of a casting and its properties, the author points out that data regarding the physical and mechanical properties of test bars are not representative of the service expected of the castings and that, in evaluating these data, factors to be considered are (a) differences in structure both macro- and micro- due to variations in rate of cooling; (b) the influence of feeding and dimensional changes on solidification in their effects on the production of shrinkage cavities of various dimensions; (c) the rate of cooling in suppressing or aiding the evolution of dissolved gases to form cavities of appreciable size and (d) internal stresses. HBG (3a)

Relining Bronze Bearing Shells with Babbitt. John S. Dean. *Transit Journal,* Vol. 79, July 1935, page 216. Trouble with worn and "bad order" armature bearings can be remedied by careful attention to details of cleaning, tinning and pouring the babbitt in the bearing shells. New shells should be bored as smooth as possible, and with old bearings the babbitt is melted at a temperature of 400° C., or over a gas flame until the babbitt runs out, and the grease is burned off. If the bearing shell is not entirely cleaned by this treatment, immersion in hot caustic potash solution is employed. If still more cleaning is necessary the bearings should be pickled in 10% H_2SO_4. For tinning, the outside of the bearing shells are coated with a mixture of red clay and water or bone ash and water. The metal bath contains 2 parts of Pb and one part of Sn and is maintained at 410°-440° C. The shell is removed, the surface to be tinned rubbed with $ZnCl_2$ flux and again immersed in the alloy bath, and immediately afterwards babbitted. Bearing shells should be kept hot just before babbitting. The babbitting jig is coated with a thin film of red clay wash or bone ash mixed with water and the babbitt is poured in a steady stream directly along the mandrel to avoid blowholes. The best babbitting temperature range is 460°-480° C. A properly relined bearing suspended by a wire and struck with a hammer will give a clear bell-like tone. A dull, dead tone indicates that the babbitt lining is loose from the shell. The babbitting pot should have automatic temperature control, tinning and babbitting alloy baths free from dross, and pouring of bearings in a vertical position whenever possible. WHB (3a)

Fettling Die Castings. E. Stevan. *Metal Industry,* London, Vol. 46, Feb. 8, 1935, pages 165-167. One of the advantages claimed for the die casting process is that it eliminates a large amount of machining. However, some pressing or fettling must be done to the castings after they leave the die. Unless this phase of the work has been carefully studied it is quite possible that the cost of finishing of the die casting will be greater than the cost of any other stage in production. This may be minimized by some extra care in the manufacture and operation of the dies if precautions are taken so that a minimum amount of fin is produced. The method used for the removal of the gates and sprues is dependent upon the size, type, shape and character of the castings. Generally some grinding and filing are required to remove the traces of gates and sprues. HBG (3a)

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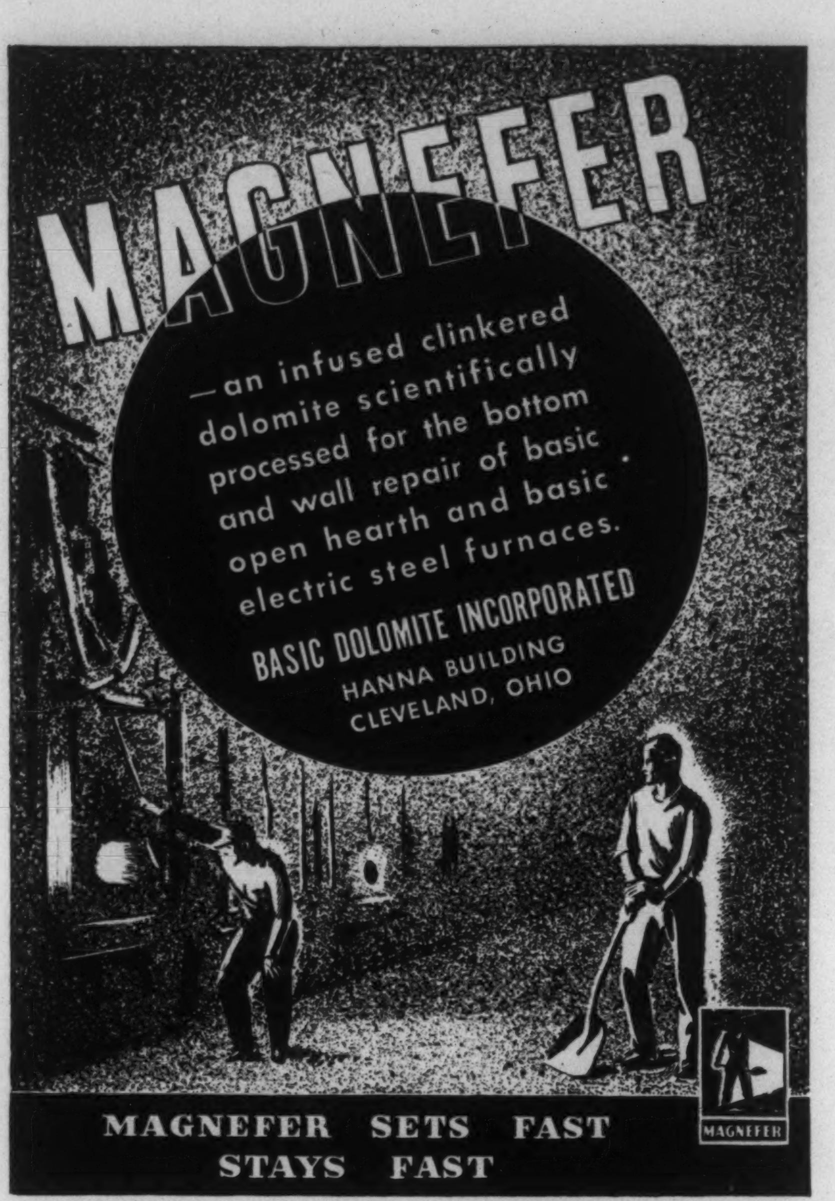
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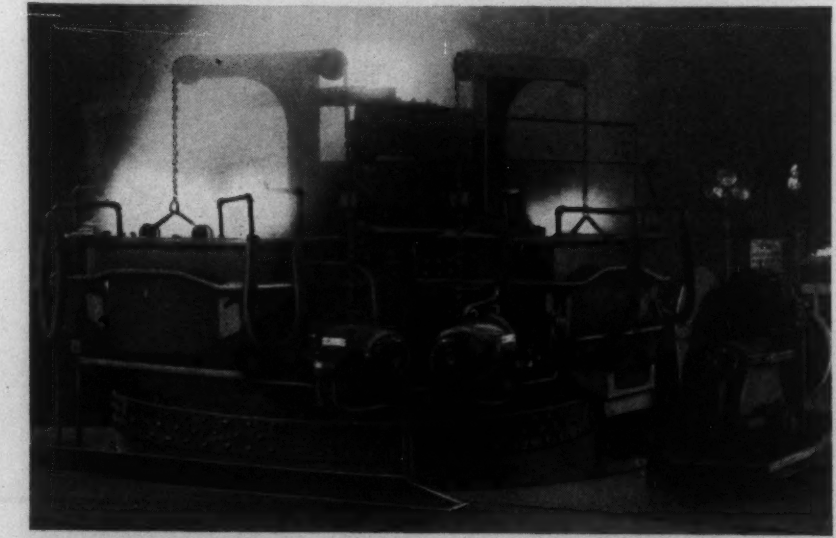

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3b. Ferrous

C. H. HERTY, SECTION EDITOR

The Manufacture of Piston Rings. JEAN CHALLONSONNET. *Foundry Trade Journal,* Vol. 53, Oct. 17, 1935, pages 295-297. Abridged translation. Wear, shape of piston rings, method of casting, qualities of cast Fe for piston rings, structures encountered in practice, heat-treatment for springing, defects, etc., are discussed. The manufacture of piston rings raises the following problems: (1) The attainment of a hardness and structure conditioned by the two corresponding characteristics of the cylinder, (2) The obtaining of maximum resilience, (3) The attainment of a high modulus of elasticity. The modulus of elasticity is regarded more and more as the best criterion of the quality of cast irons for engineering castings. Moreover, as stated by Fremont, the coefficient of elasticity of the metal increases when the resistance to transverse loading increases. Piston rings machined from cast cylinders contain a flaky coarse graphite whereas the single-cast rings show graphite in the form of much smaller division. Phosphorus eutectic is more largely developed in piston rings machined from cast cylinders than in separately cast rings, this being due to the rapidity of cooling. In the first case it produces zones of brittleness which shorten the life of the piston ring. AIK (3b)

Developments in the Production and Use of Refined and Alloy Pig-Irons in Great Britain. G. T. LUNT. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, pages 222-223. Paper presented to the International Foundry Congress in Brussels, 1935. Inherent properties and blending, the degasification process, refined malleable and cylinder pig-irons and refined alloy pig-irons are discussed. The Bradley degasification process has proved invaluable in assisting in the control of the structure of pig Fe in addition to its effect of minimizing the effect of dissolved gases and suspended inclusions. In the process as carried out at the author's firm the molten metal is taken from the refineries for treatment. The molten metal collected in the furnace is super-heated by means of oil firing, and then subjected to a powerful stirring by 4 vertical rods, coated with refractory material and arranged to rotate at different radii. Violent agitation tends to eliminate dissolved gases and suspended impurities, but it is only recently that it has come to be realized that it has an important effect in producing a finely-crystalline condition in the solidifying metal. AIK (3b)

Metallic Losses in Cupola Melting. GUY HÉNON. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, page 235. The method generally used by the author is based upon the following considerations: All the iron oxidized during the melting operation is carried away with the slag. Accurate knowledge of the weight of the slag and of its Fe content should therefore be sufficient to determine the quantity of oxidized Fe, bearing in mind the quantity of Fe brought into the slag by the limestone and the patching. The author presents an example of such calculation. Conditions for the application of the method and influence of various factors on metallic losses are also discussed. AIK (3b)

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Churned Iron and Soda Treatment. L. F. C. Girardet. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, pages 223, 236. Abstract of a paper presented to the International Foundry Congress in Brussels. The abstractor has used the word "churned" because so many words related to the centrifugal treatment of liquid metals have been associated with other processes which are current in Great Britain. The Fonte Girée which has been developed by the author refers to Fe cast into a receiver which is rotated at a critical speed. The author describes a process which includes both mechanical agitation and chemical reaction. When Fe is churned mechanically beneath a layer of liquid soda ash, there is a slipping of the metal in contact with the slag, which moves slower because of its lower density. This promotes ideal conditions for the carrying out of both chemical and physical reactions for inducing a nodular structure. AIK (3b)

Sound and Unsound Steel Castings. Jean Obrebski. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, page 226. Abstract of the Polish exchange paper presented to the International Foundry Congress in Brussels. The author has set out the following scale for the defects related to the cohesion of metal:—(1) Total lack of cohesion—microscopic draws. (2) Very feeble cohesion. The crystalline elements are separated by small blowholes and often by non-metallic inclusions. (3) Weak cohesion—neither blowholes nor non-metallic inclusions are clearly visible. The faces of the crystals are smooth. (4) Good cohesion—nevertheless insufficient to prevent the metal from dividing itself between the crystals. (5) Very good cohesion—the crystalline appearance of fractures only appears at a few points. (6) Perfect cohesion—normal fracture as one associates with forged or rolled steel of good quality. The factors which appear to favor most the presence of intercrystalline weakness in castings are as follows: (1) An excessively slow solidification; (2) too high a content of dissolved gases in the liquid metal; (3) chemical disequilibrium; (4) too great a difference between the temperatures at the start and at the finish of solidification and (5) insufficient deoxidation. AIK (3b)

Influence of Temperature Gradients in Producing Steel Castings. George A. Batty. *Foundry,* Vol. 63, July 1935, pages 28-29, 52, 55-56; Aug. 1935, pages 58, 60, 62, 65; *Foundry Trade Journal,* Vol. 53, July 25, 1935, pages 65-67; Aug. 1, 1935, pages 88-90. American exchange paper read before the annual conference of the Institute of British Foundrymen, July 1935. Influence of bottom-gating, the partial reversal method as well as the total reversal method of pouring, American and British practice, chills and controlled directional solidification, box-like castings, post solidification temperature gradient, etc. are discussed. VSP + AIK (3b)

The Soda-Ash Process in the Foundry. Achille G. Lefebvre. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, page 234. Abstract of paper presented to the International Foundry Congress in Brussels. The author outlines the reactions which take place between the soda ash and the various chemical compounds existing in cast Fe. The author suggests that it seems more rational to carry out the soda-ash treatment at the blast-furnace plant. He also deals with converter steel. AIK (3b)

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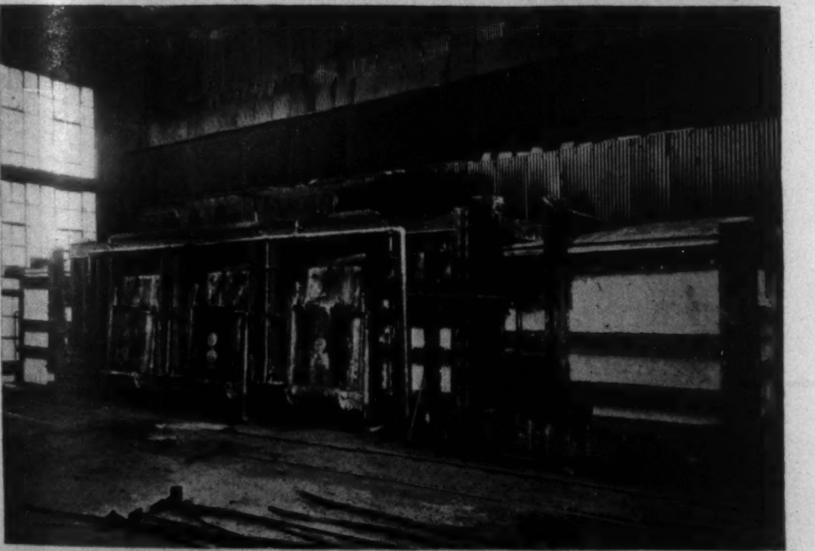

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4. WORKING

Defects Due to Improper Working of Steel. Eugene W. Nelson. *Heat Treating & Forging,* Vol. 21, Dec. 1935, pages 563-565. Discusses defects which occur as a result of improper hot and cold rolling and forging. Greatest danger in cold working is excessive working, leading to elongated grains in direction of rolling, banded structure, and cracks. If hot working is started at too high a temperature, cracks may result. Insufficient working results in coarse structure. If rolls become overheated, roll marks will form on piece being rolled and laps may result. In forging, burning or overheating of steel is to be avoided. Flow lines in forging should be so arranged that in the finished piece they will offer greatest resistance to applied stress. MS (4)

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Design and Construction of the Ford Steel Mill. M. Stone & C. F. Buente. *Blast Furnace & Steel Plant,* Vol. 23, Dec. 1935, pages 833-839. **Modern Wide Strip Mill at Ford Plant Has Many New Features.** *Steel,* Vol. 97, Dec. 16, 1935, pages 30-34, 36, 56. Describes continuous hot and cold strip mills and auxiliary equipment of Ford Motor Co., at River Rouge, Mich. Hot mill comprises primarily a 44″ blooming-mill, 2 56″ 2-high scale breakers, a 96″ 2-high broadside mill, 3 vertical edgers, a 56″ 2-high roughing mill, 2 56″ 4-high roughing-mills, and finishing mill of 5 56″ 4-high stands. Cold-rolling division consists primarily of a 56″ 3-stand, 4-high tandem mill, an 84″ 4-high reversing mill, and 2 stands of 2-high skin-pass mills 56″ wide. It will be generally equipped with anti-friction bearings, major exceptions being blooming-mill and first 3 roughing mills. All roll assemblies are balanced hydraulically. All stands, except last stand of 4-high strip mill are driven by combination gear and pinion type drives. Hot strip is cooled between roughing and finishing trains by means of air-blast. Largest part of tonnage produced will be finished in coil form. MS (4a)

Composition Roll-Neck Bearings; Water Lubricated Phenolic Laminated Materials Are Nongalling and Withstand Heavy Pounding. H. M. Richardson. *Steel,* Vol. 97, Sept. 16, 1935, pages 22-24. Deals with Textolite bearings. These are made by impregnating cotton fabric—either 4-ply interwoven belting or 8-oz. drill—with a resin varnish of the C_6H_5OH—HCOH type and graphite; drying; cutting into pieces for molding into finished bearing material; laying up in mold in laminations; and subjecting to pressure of 2000-4000 lbs./in.^{2} at temperature of 160°C. Elastic modulus in compression of material is 500,000 lbs./in.^{2}, compressive strength being 25,000-40,000 lbs./in.^{2} Textolite is nongalling, absorbs only 4-8% H_2O, and has low thermal conductivity. Maximum temperature should be limited to 300° F. Coefficient of friction of medium-weave roll-neck bearings with H_2O lubrication at pressures of 3000-4000 lbs./in.^{2} is 0.003-0.005 at rubbing speeds above 400 ft./min. Bearings made of interwoven belting are more resistant to impact and will withstand operating conditions somewhat better. Operating costs have been reduced by use of composition bearings at rubbing speeds of 100 ft./min. or above on many types of 2-high and 3-high mills. These bearings cannot be used on the ordinary 2-high hot sheet mill because of the high temperature at which rolls are operated. They are also unsuitable on slow-speed cold mills, but may be used for cold rolling where rubbing speeds are 150 ft./min. or more. Choice of most economical form of bearing depends on type of chocks and bearings on mill and on kind of work done. Provision should be made to supply at least 1 gal. of lubricating H_2O per min. for each 5 sq. in. bearing area. Where much scale is given up, well fitted scale guards should be provided over necks of bottom rolls. MS (4a)

Molded Plastic Mill Bearings Effect Large Power Savings. Harlan F. Horne. *Steel,* Vol. 97, Nov. 11, 1935, pages 36-37. Laminated phenolic resin bearings are being increasingly adopted for many types of rolling-mills. It has been found most satisfactory to manufacture radial portion of bearing independently from thrust portion, enabling either component when worn to be replaced without disturbing other. Suggested methods of application are illustrated. Advantages are a power saving of 20-40%; more efficient operation of mill due to less frequent screw-downs, and, hence, fewer test-pieces and less material scrapped because of improper gage; elimination of cost and trouble of oil or grease lubrication; increased life of bearings as compared with conventional metal type; and reduction in roll maintenance. Molded plastic bearings eventually should find wide use on all hot-mill rolling except in finishing hot sheets. In cold rolling it may be necessary to modify design of bearing from standard used in hot rolling. Micarta bearings have been used successfully on blooming-mills, rod-mills, and bar, billet, brass, hot sheet, merchant, skelp, and strip mills. MS (4a)

Ingot-Slicing and Trepanning and Drilling Machines. *Engineering,* Vol. 140, Oct. 18, 1935, pages 416-417. Illustrated article describing machines made by Messrs. Craven Brothers (Manchester), Limited, Reddish, Stockport, England. The lathe is capable of slicing ingots up to 24″ in diameter and 8′ 3″ long. Another machine is designed for trepanning the large and small sprag-holes in steel disc railway wheels. All the holes are machined in one operation and holes from 1¼″ to 6″ diameter can be made with the suitable speeds provided. LFM (4a)

Deflection of Rolls. J. Selwyn Caswell. *Blast Furnace & Steel Plant,* Vol. 23, July 1935, page 483; Aug. 1935, page 559; Sept. 1935, pages 635, 651; Oct. 1935, page 713; Nov. 1935, page 785. From paper read before the Iron & Steel Institute. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 354L/8. MS (4a)

Driving Gear for Cold-Rolling Mills. *Engineering,* Vol. 140, Aug. 16, 1935, page 179. An all-electric drive was supplied to Yniscedwyn Tinplate Company, Limited, Swansea, by David Brown and Sons (Huddersfield), Limited, of Huddersfield. Two drives were supplied, one of 85 h.p. and the other of 55 h.p. The former consists of a double-reduction helical main gear, a worm-reducing gear for barring purposes, main driving and barring motors and motor-control gear, all mounted on a cast-iron bedplate. LFM (4a)

Modern Sheet Mill in Australia Is Adapted to Diversified Products. *Steel,* Vol. 97, Nov. 18, 1935, page 58. Describes mill at plant of Australian Iron & Steel Co., Ltd., Sydney, Australia. It is equipped with a 3-high H_2O mill, a 2-high hot sheet mill, and a stand of cold rolls. MS (4a)

Continuous Mill Built with Aligners to Overcome Roll Neck Deflection. *Steel,* Vol. 97, Aug. 19, 1935, page 38. Describes roller bearings which will be installed in a 4-high continuous hot strip mill and 2 temper pass mills. Roller aliners will be installed in 1 stand each of the roughing and finishing mills. Device consists of a large hardened and ground steel roller placed between hardened and ground flat steel plates transverse to the roll axis. When neck deflects under rolling load, rollers move slightly outward permitting chock to tilt to the same angle as the deflected rock. Angles of deflection up to 0.012″/ft. are completely compensated for by the aliner. All bearing rollers and races will be made from SAE 52100 high-C Cr electric furnace through hardening steel. MS (4a)

Classifier for Cold Rolled Sheets Separates Accurate from Off Gages. *Steel,* Vol. 97, Sept. 9, 1935, pages 40-41. Classifier was developed by Jones & Laughlin for grading sheets produced from continuous strip according to deviations from specified tolerances. It can be used at a speed of about 400 ft./min. Gage measuring device is a flying micrometer, mounted ahead of the pinch rolls feeding the flying shear. It consists of 2 small rolls through which the strip passes. One is fixed, while the other moves according to variation from gage of strip, and, by means of an armature attached to it, produces correspondingly slight variations in voltage in opposed induction coils. These small electrical changes are transmitted by suitable contactors to thyratron tubes and through suitable time delay relays operate the classifying-table solenoids, which operate the gates through which the classified sheet is thrown into the correct pile. Gaging of strip is done near 1 edge. MS (4a)

Carnegie-Illinois 43-In. Strip Mill. *Blast Furnace & Steel Plant,* Vol. 23, Dec. 1935, pages 867-869. **New 43-Inch Strip Mill at McDonald Works Is Completed.** *Steel,* Vol. 97, Dec. 30, 1935, pages 34-35, 40. Brief description of mill and auxiliary equipment erected at Youngstown, O. Mill is of the continuous type and can deliver rolled product from finishing stand at 2000 ft./min. MS (4a)

Timken Bearings for Cold-rolling Mill. *Engineering,* Vol. 140, Aug. 16, 1935, page 178. **Ford Completes Hot Strip Mill and Cold Finishing Mill.** *Iron Age,* Vol. 136, Nov. 28, 1935, pages 19A-19H, 80. Illustrated brief article on the bearings made for the Ford Motor Company plant at River Rouge, Michigan, which is being erected by the United Engineering & Foundry Company. The bearings will carry a load up to 2000 long tons at 25 r.p.m. Each bearing weighs nearly 4 tons. Timken bearings of 87 different sizes are being used in the mill. VSP + LFM (4a)

Flexibility as a Factor in the Economic Exploitation of Rolling Mills. George A. V. Russell. *Blast Furnace & Steel Plant,* Vol. 22, Dec. 1934, page 719; Vol. 23, Jan. 1935, page 88; Feb. 1935, page 152; Mar. 1935, pages 218-219; Apr. 1935, page 286; May 1935, page 350; June 1935, page 426; July 1935, page 494; Aug. 1935, page 570; Sept. 1935, page 646; Oct. 1935, page 724; Nov. 1935, page 796; Dec. 1935, page 880. From first 2 sections of paper presented before the Iron & Steel Institute. See *Metals & Alloys,* Vol. 5, Dec. 1934, page MA 559. MS (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Cracks in Forged Pieces (Les "Flocons" dans les Pièces forgées). L. Guillet & M. Ballay. *Usine,* Vol. 44, Nov. 14, 1935, pages 27-29. The cause of fine fissures which sometimes are observed in large forged or rolled pieces and which are quite different from the dendritic and quenching cracks, was investigated but a satisfactory solution of the problem has not been found. The tendency to form these cracks (in French "flocons") was found to exist in increasing degree in C steel, Mn steel (1-1.5%), Mn-Si steel, steels with 1-2% Cr with or without Mo, Ni steel (1.5%), Cr-Ni steel, Cr-Ni-Mo steels in the order named. Steels made in the crucible, or acid open-hearth, or in a high frequency electric furnace are, in general, less subject to these cracks than the basic open-hearth or electric arc furnace steels. The tendency diminishes if temperature and velocity of pouring are reduced. Sufficiently slow cooling after forging is also important, about 1°/min. between 800° and 200° C. seems sufficient which would mean about 10 hrs. for this interval, and for very large pieces even longer, up to 80-100 hrs. The orientation of these cracks is perpendicular to the greatest deformation pressure and to the dendrites. Impurities do not seem to play any part. Ha (4b)

Continuous Lead Cable-Sheathing and Pipe-Forming Machine. *Engineering,* Vol. 140, Oct. 18, 1935, pages 412-415. Illustrated article describing a machine made by Messrs. W. T. Henley's Telegraph Works Company, Limited, London. The striking feature of the machine is that the flow of Pb is continuous thus doing away with the objectionable formation of ridges or stop marks caused in using the old type of machine which requires the press to be re-filled with Pb. Another advantage is that uniformity of thickness of either sheathing or piping is readily obtained. The molten Pb is protected inside the machine so that it is never exposed to the air with the danger of the formation of oxides which lead to weak spots in sheathing or pipes. LFM (4b)

Brass and Copper Forgings. Their Manufacture, Properties and Uses. Edwin F. Cone. *Metals & Alloys,* Vol. 6, Dec. 1935, pages 337-341. Assembles data on forging properties of several Cu alloys. Compositions, forging practices and equipment, and the microstructural effects of forging are described and discussed. WLC (4b)

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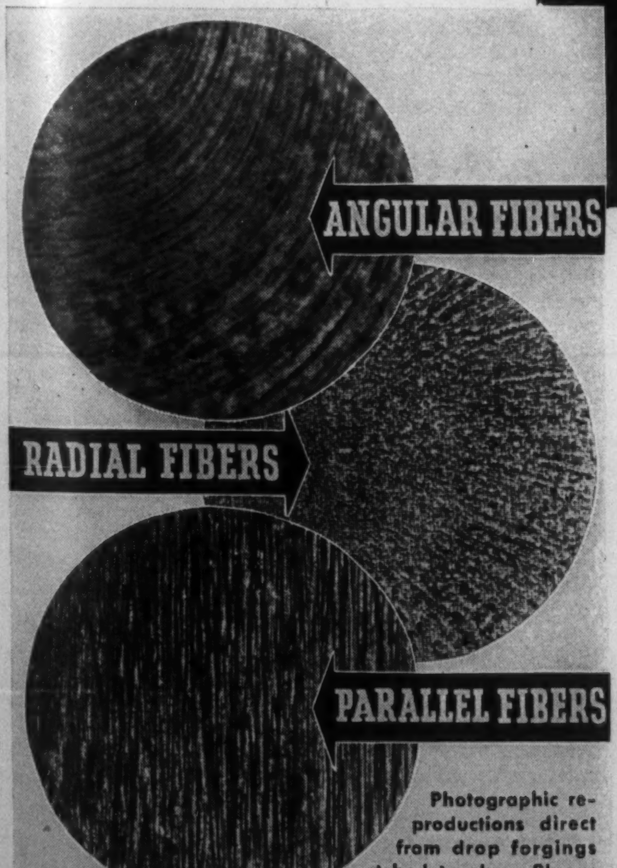

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■ 4c. Cold Working, including Shearing, Punching, Drawing & Stamping ■

Small Lot Stampings at Low Cost. K. W. Peterson, *American Machinist*, Vol. 79, Sept. 25, 1935, page 723. A practical suggestion is made for simplifying tools and dies if only a small quantity of stamped goods is required. It is recommended to hard-face both the cast Fe punch holder and the cast Fe bolster with hardened and ground tool steel plates. Ha (4c)

Manufacture of Seamless Copper Tubes (La Fabrication des Tubes de Cuivre sans Soudure). L. Matteoli. *Cuivre et Laiton*, Vol. 8, Sept. 30, 1935, pages 397-400. Mannesmann process, extrusion methods and Rockrite process are described. Ha (4c)

Stainless Steel Wire Finds Diversified Uses; To Produce It many Closely Controlled Operations Are Required. J. K. Findley. *Steel*, Vol. 97, Aug. 26, 1935, pages 28-30. Describes practice of Ludlum Steel Co. in producing fine wires as small as 0.004 in. diam. from ¼ in. rounds. MS (4c)

Stamping Brass Caps. A. G. Arend. *Metal Industry*, London, Vol. 46, Feb. 15, 1935, pages 189-190. Due to the wide variety in shapes and sizes and the profusion of makes to meet the demand, no one method can be used to make all of the brass caps used commercially. Orders are generally for only a small quantity and yet precision is required as the caps are frequently used as parts of precision instruments. Both top and bottom dies are necessary. The machines used for stamping are fairly uniform and die construction represents the greatest item in the process of manufacture. Brass of the class composition 65% Cu-35% Zn is most generally used. Ordinary yellow brass and Muntz metal are also used but the selected stamping brass seldom leads to cracking trouble. Economical production does not necessarily mean adopting the fewest number of processes with the risk of overworking the metal. Annealing must be carried out with respect to the crystalline structure. Especially when dealing with small sections, once the caps have been successfully annealed at a definite temperature for a definite number of minutes, these conditions should be adhered to for future work. Following this schedule little trouble should then be experienced. Different methods are used to form the caps which may be either clenched or curled. The action of the die and the method of curling the caps are described. HBG (4c)

Deep-drawing Stainless Steel. Particulars of the Latest German Practice. *Machinery*, London, Vol. 46, Sept. 19, 1935, pages 784-785. A die ring of steel with core hardness of 180-200 Brinell should be used with nitrided case to reduce wear or special wear-resisting alloy steels. If cast Fe punches are used they should be faced with a steel case up to the height of the drawn shell. Clearance between die and punch should not be less than the thickness of the stock and the finish drawn piece should have the same thickness as the original sheet. The diameter reduction for steps in the drawing are found by the use of formulas and equations while tables give the values of the constants for the equations for various thicknesses of the stock. The annealing and pickling procedure is briefly sketched. WB (4c)

Internal Stresses in Swage—Polished Steel Rods (Eigenspannungen in Prägepolierten Stahlstangen). H. Bühler. *Archiv für das Eisenhüttenwesen*, Vol. 8, May 1935, pages 515-516. The internal stresses arising in 0.10 and 0.19% C steel rods after swaging were studied. High surface compressional stresses were found, these increasing with the amount of deformation. Swaging with 1 or 3 rolls had about the same effect. Since only the surface is deformed especially in thicker rods, only small tensional stresses form at the interior. The high compressional stresses at the surface raise the endurance limit against bending stresses. SE (4c)

■ 4d. Machining ■

H. W. GRAHAM, SECTION EDITOR

Carbide Tools (Hartmetallwerkzeuge). K. Becker. Verlag Chemie, Berlin, 1935. Cloth, 5¾ x 8 inches, 215 pages. Price 18 RM.

Practical hints are given on copper-brazing and other methods of joining carbide tips to tool bodies, on grinding and lapping the tools, and on tool forms and angles for varying types of service. Speeds and feeds for different makes of carbide tools made by German manufacturers, in many kinds of service, including cutting austenitic manganese steel, silicon iron castings, glass, etc. are tabulated. Many illustrations show how all kinds of tools are tipped and ground. Wire-drawing dies and plug and other gages, sandblast nozzles and the like are briefly discussed. A list of German patents is appended. Becker thinks that the variety of grades in which carbide tools are made in the United States for approximately the same service, as well as the price, hold back development. Even allowing for the gold value of the dollar, United States prices are about 2½ those in Germany. German production has doubled in the last year and now amounts to over 7500 lbs. per month. H. W. Gillett (4d) -B-

Temperature Control with Simple Means (Temperaturkontrolle mit einfachen Hilfsmitteln). E. Zurbrügg. *Aluminium*, Vol. 17, Oct. 1935, pages 533-534. Chipless forming of light metals must be done in a definite temperature range within which it can be done with the least energy consumption without overheating. A table gives characteristic effects when bringing sugar, soap and firwood into contact with the metal surface at temperatures ranging from 160° to above 500° C.; they can be used to keep the temperature within the desired limits. Ha (4d)

Cemented-Carbide Cutting Tools in Present-Day Shop Practice. R. D. Prosser. *Machinery*, N. Y., Vol. 42, Dec. 1935, pages 268-270. The increased use of cemented-carbide cutting edges in machine tools is pointed out and the advantages in increased production are explained. The increase in production in machining steel is about 35%, in cast Fe about 60%. Cutting speeds and grinding methods are given. Ha (4d)

5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Effect of Grain-Size Upon Some Physical Properties of Medium Carbon Steels. Frederick G. Sefing & Kenneth J. Trigger. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 782-796. Authors conclusions are (1) fine grained steel does not crack while coarse grain steels always crack in light and medium sections (up to 3″) when hardened, (2) cracking tendency is apparently associated with inclusions, (3) fine grained steel should be used to hold volume changes in hardening and tempering to a minimum, (4) higher surface hardness may be obtained on coarse steel, (5) fine grain steels are tougher, and (6) duplex condition of mixed grain size may result in characteristics of either class but without dependability. Fine grain is 5-9 and coarse 1-4 A.S.T.M. grain size. WLC (5)

Cause and Avoidance of Cracks in Heat Treated Steel. J. C. Oliver, W. N. Barrows & R. J. Williams. *Heat Treating & Forging,* Vol. 21, Nov. 1935, pages 525-531; Dec. 1935, pages 581-583. Paper read before the Steel Treatment Research Society, Australia. Discusses in a general manner the high lights of the causes of failure in heat treated steel. Discusses subject under the headings of selection of steel; design as it affects heat treatment of various parts; heat treating processes; grinding and finishing; and service failure. MS (5)

Heat Treating 1000 Different Parts. J. B. Nealey. *Steel,* Vol. 97, Dec. 23, 1935, pages 24-26. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 395R/2. MS (5)

■ 5a. Annealing ■

Deformation of Tool Steel During Hardening and Annealing (Undersökning beträffande verktygsstals dimensions-förändring vid härdning och anlöpning). Einar Ameen. *Jernkontorets Annaler,* Vol. 119, Sept. 1935, pages 359-399. Tests were made on 5 kinds of steel; viz., very pure 1% C steel hardened in water (I); material of the same analysis as (I) but with less hardening area and deeper penetration (II); water-hardened tungsten steel (III); Cr-V-W steel, of the non-deforming type, hardened in oil (IV); Cr-Mo-V non-deforming steel, hardened in air (V). For comparison very soft iron of great purity (VI) was used. The general conclusions are summarized as follows: Deformation results partly from strains due to heating and partly from structural changes. Thermal effects cause spherical deformation, while structural effects cause the opposite. Rapid cooling rates and poor heat transfer emphasize thermal deformation. Structural deformation decreases if a separate phase is present which does not change structure such as residual austenite or excess carbide. In test pieces which harden through completely, steels I, II and III show about equal deformation, while steel IV shows about one-half as much and steel V one-fourth as much. When the hardening is not carried through the test piece, steels I, II, and III are about as good as V, while IV gives much greater deformation. In order to obtain minimum deformation it is desirable (a) to cool as slowly as possible during hardening, (b) to build up the residual austenite, and (c) to provide a good excess of carbide. Relief of deformation strains takes place rapidly at temperatures down to 200° C. and from there on more slowly. Annealing will eliminate deformation completely in exceptional cases only, but the best results are obtained when tests are first made on special pieces. A ring formed test piece with 15 mm. outside diameter, 5 mm. inside diameter and 10 mm. height is recommended for accurate measurements. For grosser measurements a cylinder of 50 mm. diameter and 50 mm. height is satisfactory. HCD (5a)

■ 5b. Hardening, Quenching & Drawing ■

On the Quenching Medium. Otoo Hara. *Tetsu to Hagane,* Vol. 21, Oct. 25, 1935, pages 802-811. In Japanese. By use of seed oil, soy-bean oil, and fresh and old fish oils, the effects of viscosity and vaporization of the quenching media on the cooling velocity of quenched steel were determined. (1) The mean cooling velocity increases as the temperature of oil rises. When the quenching temperature is high, the cooling velocities are high and low in the vegetable and fish oils, respectively. The cooling velocity is high in the order of fresh fish oil, seed oil, soy-bean oil, mixed oil (seed oil + old fish oil) and old fish oil. (2) Relation between the coefficient of viscosity (η) and temperature (t) of oil is given by the equation, $(\log \eta + 2)^3 = K\left(\frac{1}{t} - 0.006\right) - 0.22$, where K is constant which varies with the kind of media. (3) Relation between the mean cooling velocity (v, °C./sec.) and the coefficient of viscosity is represented by the formula, $v = \frac{1}{A}\log\frac{1}{\eta} + B$, where A and B are constants shown in the table. (4) By the addition of less than 1% water to oils, the viscosity and the mean cooling velocity decrease, on account of the fact that water contained in oil vaporizes during quenching. (5) As the quenching temperature rises the mean cooling velocity in old fish oil decreases while the velocity increases in seed oil. (6) The seed oil is not easily oxidized, so its viscosity is unchanged by use. On the contrary, soy-bean oil is easily oxidized and its viscosity increases.

	Constants		
	K	A	B
Seed oil	140.0	0.027	193
Soy-bean oil	173.5	0.025	170
Fresh fish oil	85.5	0.028	203
Old fish oil	308.5	0.027	96
Mixed oil	200.0	0.021	131

TS (5b)

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On the Quenching of Steels and Its Mechanism. KOTARO HONDA. *Science Reports Tohoku Imperial University*, Vol. 24, Nov. 1935, pages 551-564. A summary is given of the theory of quenching steel as developed by Dr. Honda and facts on which the theory is based. Following general acceptance of the idea of the two stepped change of A_1 transformation—from austenite to martensite to pearlite—the theory that martensite is a solid solution of C in ferrite was established by proving that the axial ratio of the tetragonal body-centered lattice of α martensite increases in proportion to the amount of C present. The theory that β martensite is also a solid solution, maintained by Honda, differs from the more wide spread assumption that it is a decomposed product of α martensite in which cementite particles are finely dispersed in ferrite ground. Investigations in Japan have shown the nature of β martensite to be the same as α martensite except in the position of C atoms in the iron lattice, hence the solid solution theory is at present to be considered as the correct one. In α and β martensites C atoms occupy the positions (½, ½, 0) and (½, ¼, 0) of the tetragonal and cubic lattice respectively. BWG (5b)

Faulty Heat Treatment of Steel Tools (Zur Beurteilung von Fehlern bei der Härtung von Stahlwerkzeugen). *Die Metallbörse*, Vol. 25, May 25, 1935, pages 657-658; June 8, 1935, page 722. Instructions are furnished for determining and avoiding the faulty heat treatment of tool steel. EF (5b)

Heat Treatment of Spring Leaves. W. T. DONKIN. *Industrial Heating*, Vol. 2, Nov. 1935, pages 641-644, 648, 672. Operation of hardening and tempering furnace are described. The steel used for springs contains 0.63-0.68%C, 0.7-0.9% Mn, 0.04% max. P, 0.04% max. S, 0.2-0.3% Si, 0.15-0.25% Mo. The springs are hardened at 1475° F. and drawn at 810° F. The Brinell hardness is 444. Ha (5b)

■ 5c. Aging ■

Magnetic Investigation of Precipitation Hardening (Magnetische Untersuchung der Ausscheidungshärtung). HERRMANN AUER. *Physikalische Zeitschrift*, Vol. 36, Dec. 1, 1935, pages 880-882. Paper before the XI. Deutscher Physiker und Mathematiker Tag, Stuttgart, Sept. 22-28, 1935, reports on a magnetic investigation of precipitation kinetics in Al-Cu alloys with 1.2-5% Cu. The considerable loss of susceptibility of precipitation hardening alloys during the break-down of the homogeneous solid solution and the linear course (logarithmic scale of time axis) of the susceptibility curve offers a valuable means of studying the reaction rate with reference to various thermal treatments. The discontinuous relation between the final susceptibility value and the quenching temperature was used to re-establish the binary constitutional diagram Cu-Al, (which corroborated the microscopically established diagram of Dix & Richardson). A quantitative evaluation of the susceptibility of the heteroogeneous alloy after it attained its state of equilibrium permitted determining the stoichiometric formula of the precipitated phase ($CuAl_2$). The temperature relation of the susceptibility of pure Al and of Cu-Al alloys after attaining their equilibrium in the state of heterogeneity obeys a modified Curie law. The marked deviations from the Curie law during the precipitation are connected with the oversaturation of the solid solution. As an example of applying the magnetic testing method to special age-hardening problems, the effect of the quenching speed on the precipitation was studied. EF (5c)

Time and Temperature of Maximum Age Hardening. E. H. BUCKNALL. *Metal Progress*, Vol. 28, Dec. 1935, pages 53, 78. Study of a Ni-Si-Cu alloy shows a steady rise in hardness to a flat maximum followed by a steady fall with time for any given temperature. The maxima are higher for lower temperatures. For a given aging time the best temperature is that at which full hardness is just attained. Plotting specific treatment by log of time vs temperature resulted in separation by a straight line of treatments in which hardening was still proceeding from those where full hardness had been reached and softening started. This line has the equation $t = C\,e^{\frac{m}{T}}$ where T is temperature and t is time and is similar to the equation established for diffusion in the solid state. WLC (5c)

The Aging of Steel. E. S. DAVENPORT & E. C. BAIN. *Transactions American Society for Metals*, Vol. 23, Dec. 1935, pages 1047-1106. 61 references. Discussion. Study of the aging effects in low C steel leads to conclusion that precipitation phenomena of 2 types are the cause: (1) in annealed steel Fe-carbide is precipitated from ferrite (supersaturated with carbon) in a random manner throughout the grains and (2) ferrite seemingly supersaturated with O rejects Fe-O compound in slip bands of cold worked grains. Pre-aging or complete precipitation in a state of dispersion to produce no hardening is prescribed for (1) and similar treatment can be used to minimize the effects of (2). WLC (5c)

■ 5f. Nitriding ■

Nitriding of High Carbon Globulized Cementitic Steel. TOSHIJIRO TAZAWA. *Seitetsu Kenkyu*, No. 143, June 30, 1935, pages 297-310. In Japanese. Specimens consisting of globular cementite and pearlite were prepared as follows; pieces of plain C steel (0.75-1.31% C) were heated to 900° and quenched in a bath of mixed salts of LiCl and $NaNO_3$ and then tempered at 640° for long time. The specimens thus prepared were nitrided in current of NH_3 gas at 660° for 20-30 hrs., and then were subjected to microscopical study and Brinell hardness test. C and N in the surface part of the nitrided specimens were chemically analysed. Results were as follows; (1) The penetration of N into high C steel having normal structure is difficult, but into globulized cementitic steel is somewhat easy, and it is attributed to the fact that the matrix of pearlite connects by globulizing of cementite. (2) In high C globulized cementitic steel, high N layer is not obtained even in the outermost part of specimen, that is, N content is only less than 1% in that part. (3) Pearlite cementite globulizes in the course of nitriding. TS (5f)

Reducing Spalling on Nitrided Dies. BERNARD THOMAS. *Metallurgia*, Vol. 13, Nov. 1935, pages 23-25. To prevent spalling corners should be rounded to a radius of 3/128". JLG (5f)

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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Development of Convection Heating Equipment. *Industrial Heating,* Vol. 2, Sept. 1935, pages 476-492; Oct. 1935, pages 601-602; Nov. 1935, pages 669-670; Dec. 1935, page 711. The developments in this field are reviewed and furnaces and their equipment with particular consideration of metallurgical operations are described with many practical examples illustrated. Ha (6)

Some Uses of Insulating Fire Brick in Modern Foundry Practice. C. L. Norton, Jr. *Industrial Heating,* Vol. 2, Nov. 1935, pages 654, 668-670. Advantages and disadvantages of insulating fire brick used in the melting of non-ferrous alloys and in the heat treatment of steel castings are outlined. Fuel savings are possible. A few examples are described. Handling of the bricks is an important factor for their behavior and life. Ha (6)

Mikro-Asbest (a Fibrous, Wooly Fine Asbestos) for Filling Material (Mikro-Asbest (ein faseriger, wolliger Klein-Asbest) als Füllstoff). Heinrich Rosenberg. *Montanistische Rundschau,* Vol. 27, Nov. 1, 1935, pages 1-11. Gives numerous application of fine asbestos powder, mixed with bitumen, slag wool, or other material for insulating industrial and electric furnaces. Mixed with various binders it is also used for rustproofing iron and for protection of non-ferrous metals. BHS (6)

Industry Demands Electric Heat. C. R. Stevens. *Electric Journal,* Vol. 32, Aug. 1935, pages 321-322. Advantages of melting steel in electric furnaces are discussed as well as applications of electric melting furnaces in the non-ferrous industry. New applications in annealing and heat-treatments in both ferrous and non-ferrous fields are being made with a reduction of over-all cost of the finished products. CBJ (6)

Developments and Trends in Refractories. L. J. Trostel. *Brick & Clay Record,* Vol. 87, Sept. 1935, pages 92-94; Oct. 1935, pages 127-130; Nov. 1935, pages 164-168. Manufacturing processes of refractories, materials used and properties are reviewed exhaustively and modern efforts to create a heat-insulating refractory which will stand high temperatures are discussed. Special applications in the steel and glass industry described. Economy in the use of the new refractories is mostly realized in industrial heating operations of intermittent character. Silica, magnesia, and fireclay bricks in their particular fields are discussed. Ha (6)

Electric Heat Treatment. George L. Hall. *Electrical World,* Vol. 105, Aug. 31, 1935, pages 2104-2106. Heat treatment and heat-treating processes are defined. Types of electric heat-treating furnaces discussed are: (a) box type, (b) pit type, (c) rotary hearth, and (d) air-draw or tempering. CBJ (6)

Controlled Atmospheres in Electric Furnaces. George L. Hall. *Electrical World,* Vol. 105, Sept. 14, 1935, pages 2205-2207. Control of atmosphere is discussed for the following methods of treatment: (a) carburizing, (b) nitriding, (c) precision tempering of ferrous materials, (d) bright annealing, and (e) brazing. Approximate cost of various gases used is given in a table. CBJ (6)

Electric Furnaces with Carbon Radiator. Henri George. *Electrical Engineering,* Vol. 54, Nov. 1935, pages 1195-1199. For furnaces of very high temperature, resistance elements of C have proved to be very advantageous. They radiate their heat to the material to be heated (steel to be melted, etc.) and have a power factor as high as 0.98. Some operating data in French plants are given. The particular advantages claimed are: Flexibility, uniformity of temperature, definite atmosphere, possibility of operating in a vacuum, easy regulation of the carburization, facility of reduction processes, and last, but not least, the constancy of the analysis of the metal prior to and after fusion. Ha (6)

Improved Vertical Hot Tube Annealers. Lee Wilson. *Industrial Heating,* Vol. 2, Nov. 1935, pages 659-662, 667. A bell-type furnace with vertical tubes in the inside is described; gas is burned at the lower end of the tubes, which radiate their heat into the interior of the furnace. Ha (6)

Electrically Heated Furnaces in a Hardening Plant (Elektrisch geheizte Oefen in einer Härterei). J. H. Rayer. *Elektrotechnische Zeitschrift,* Vol. 56, Sept. 5, 1935, pages 981-982. Operating data of electrical furnaces for annealing, heating of oil and salt baths, with some design data are given. Ha (6)

Heat Treatment by Forced Convection. W. H. Darrah. *Metal Progress,* Vol. 28, Nov. 1935, pages 55-60, 80. Heating by forced convection in a hot atmosphere results in maximum rate of heating, minimum difference of temperature in the charge, high fuel economy and relatively low initial cost. Discusses operating conditions and applications. Applications have been confined to temperatures of 200°-1600° F. WLC (6)

Refractories from a Metallurgical Viewpoint. G. E. Seil. *Industrial Heating,* Vol. 2, Sept. 1935, pages 517-521, 538-540; Oct. 1935, pages 587-590; Nov. 1935, pages 651-653; Dec. 1935, pages 713-717. The classification and manufacture of refractory materials is described at length, the structure micrographically studied; the characteristics, influence of temperature on change of shape and methods of installation discussed. Proper choice of refractory materials and proper handling of the bricks in installing them is important for obtaining best service for a given metallurgical process. Chemical compositions and micrographs of structures are given. Ha (6)

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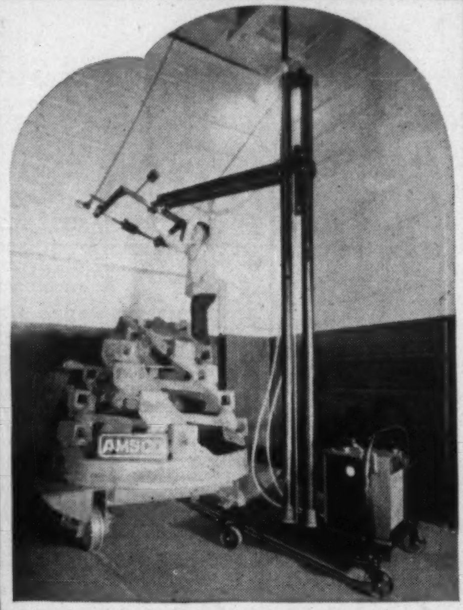

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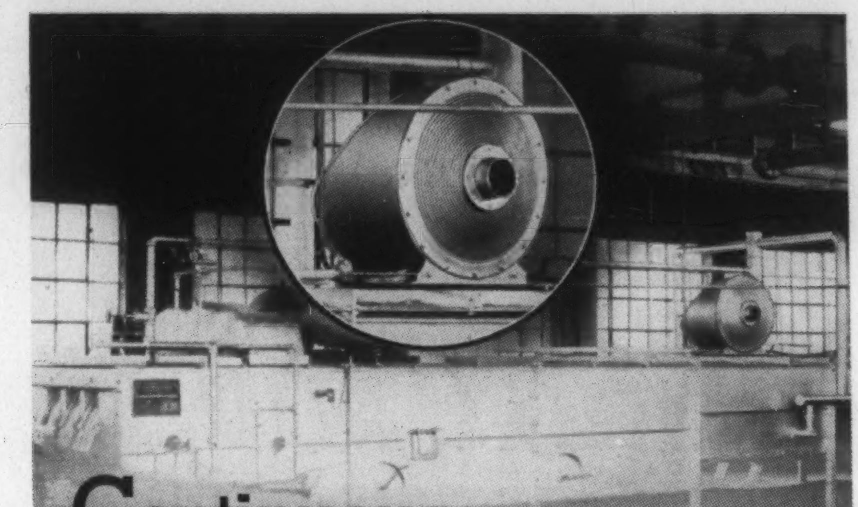

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Controlled Atmospheres in Steel Treating. A Correlated Abstract. H. W. GILLETT. *Metals & Alloys*, Vol. 6, Aug. 1935, pages 195-207; Sept. 1935, pages 235-246; Oct. 1935, pages 293-298. 86 references. Assembly of data and discussion of character of usable gases, temperature ranges of application and reaction of steels at these temperatures. Discusses cost and action of different usable gases. Furnaces are discussed as their character affects the application to them of controlled atmosphere. Experiences and experiments are correlated and it is stated that the problem of controlled atmosphere for treating high speed steel is simply solved. Entire elimination of H_2O from the atmosphere for heating C and alloy steel for quenching and for bright annealing is the principal difficulty in control. Heating for forging cannot be satisfactorily effected with freedom from scaling. WLC (6)

Open-Hearth Roof Temperatures. H. M. SCHMITT. *Metals & Alloys*, Vol. 6, Dec. 1935, pages 333-335. 4 types of installation for determining and recording temperatures of open-hearth roofs are described. Their limitations and usefulness as a guide to longer life of roof are discussed. WLC (6)

Designs New Checker for Regenerator Chambers. M. K. MELLOTT. *Steel*, Vol. 97, Dec. 23, 1935, page 42. Describes Superior open-hearth checker-brick. It is made for any standard size flue, with a brick depth of 2½″ or 3″, and a thickness as close to 2″ as commercially practical. In laying up bricks in a chamber, each checker is interlocked with adjoining checkers at all 4 corners, and each course is locked into adjoining course, preventing shifting or twisting and obstruction of flues. Comparison of heating surface and free area obtained with new checker design and with standard 9″ x 4½″ x 2½″ bricks laid up to form 6″ x 6″ flues shows that former gives 18% more heating surface and 60% more free area. When laid up to form 5″ x 5″ flues, increase in heating surface is 23% and in free area, 75%. MS (6)

Industrial Electrical Heat (Industrielle Elektrowärme). H. MASUKOWITZ. *Elektrizitätswirtschaft*, Vol. 34, Aug. 15, 1935, pages 499-504. Present state, advantages and economy of electrical heating. The greater part of the paper refers to metallurgical furnaces. WH (6)

New Oil-Fired Assay Furnace Combines Roasting, Fusion, and Cupellation. G. B. O'MALLEY. *Chemical Engineering & Mining Review*, Vol. 28, Oct. 8, 1935, pages 491-492. An illustrated description. WHB (6)

Forging Furnaces at the Ford Plant. J. B. NEALEY. *Metals & Alloys*, Vol. 6, Dec. 1935, pages 351-354. Describes standardization of Ford plant on gas fired forging furnaces, some 50 converted from electric fuel. Operating methods are described. Editorial comment is made on the folly of generalization from such change over and adoption of any particular fuel without study of economics of the situation. WLC (6)

Contributory Effects of Furnace Atmosphere on the Grain-Size of Molybdenum High Speed Steel. ARTHUR PHILLIPS & M. J. WELDON. *Transactions American Society for Metals*, Vol. 23, Dec. 1935, pages 886-914. 14 references. Discussion. Steel studied contained C 0.77%, Mn 0.32%, Si 0.47%, Cr. 3.93%, Mo 7.05%, V 2.05%, W 0.07% in the form of 1/16″ sheet carefully rolled with borax protection. In the discussion objection is made to validity of results on such thin sections with mill scale remaining on them. Results of varying atmospheric conditions indicate that oxidizing atmospheres, particularly when containing H_2O, produces most pronounced structural effects. No evidence of "self heating" was observed. WLC (6)

Waste-Heat Boilers in Open-Hearth Practice. *Engineering*, Vol. 140, Oct. 4, 1935, pages 370, 375-376; *Engineer*, Vol. 160, Oct. 4, 1935, pages 354-356. See *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 494R/8. LFM (6)

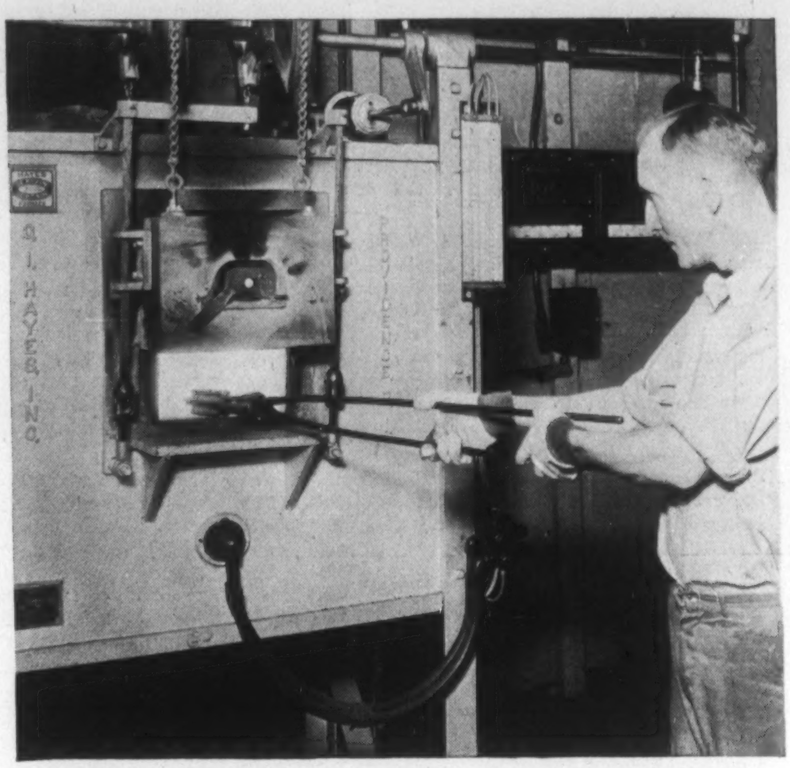
Note on the Failure of a Gold Fuse in Contact with Nickel-Chromium Alloy. M. C. CAPLAN. *Metal Industry*, London, Vol. 47, Sept. 13, 1935, page 274. A short abstract of the paper. See *Metals & Alloys*, Vol. 6, Nov. 1935, page MA 451R/3. HBG (6)

New Application of the Ritex Process to the Manufacture of Chrome Brick. R. P. HEUER. *Steel*, Vol. 97, Aug. 19, 1935, pages 22-25, 30, 32. Ritex process, already used for making unburned magnesite brick, has been applied to chrome brick. Ritex chrome brick contain about twice as much MgO as regular burned chrome brick. Comparative tests showed that the Ritex brick had greater density, crushing strength, refractoriness under static load, volume stability, and resistance to spalling, and lower thermal conductivity. Increased MgO content accounts, in part, for improved physical properties. Tests in commercial basic open-hearth furnaces showed that the unburned brick can be used satisfactorily along the slag line in place of ordinary chrome and magnesite brick, and above the slag line as a substitute for silica brick in front and back walls all the way up to the main skew backs, and other places. They are not recommended for open-hearth roofs. MS (6)

Atmospheric Control in Radiant Tube Furnaces. W. M. HEPBURN & H. C. WELLER. *Metal Progress*, Vol. 28, Aug. 1935, pages 41-45, 66. Describes use of heat resisting alloy tubes in which gas burns by diffusion combustion for economical heat. Discussion of conditions is carried out by a question and answer method. WLC (6)

Waste Heat Boilers Installed in a British Copper Refining Plant (Abhitzekessel in einer englischen Kupferraffinerie). *Die Wärme*, Vol. 58, Jan. 19, 1935, page 42. Detailed data are given on 2 Cu refining furnaces and their waste heat boilers installed during the last 2 years at Prescot, Lancashire. A 170 ton furnace requires 24 tons of powdered coal/day (ash content = 3.5-4.5%) which furnishes 113 tons steam at 10 atm. and superheated 85°C. When leaving the furnace the temperature of the flue gases is 1200°-1260° C. and drops to 200° C. after passing the waste heat units. The steam is sold to an outside company. EF (6)

Development of Electric Furnaces in Metallurgy (Le Développement des Fours Electriques dans la Métallurgie). *Electricité (Science et Industrie)*, Vol. 19, Nov. 1935, pages 480-481. General article. Development is shown by examples taken in Germany and in France. FR (6)



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Siemensite and Its Application in the Basic Open-Hearth Furnace (La "Siemensit" et son Application au Four basique Siemens-Martin). E. Greiner. *Revue Universelle des Mines,* Vol. 11, Nov. 1935, pages 502-506. Operating data with siemensite, composed of 20-40% Cr_2O_3, 25-45% Al_2O_3, 18-30% MgO and 8-14% other constituents, are given. The material is obtained by reducing fusion in an electric arc furnace and casting in chill molds. The heat resistance is higher than Seger cone 42, sp.gr. 3.2-3.4; it softens under 2 kg./cm.² pressure above 1800° C. Comparisons with other refractories are compiled in tables. Ha (6)

Fuel Economy in Iron and Steel Works. F. Bainbridge. *Iron & Coal Trades Review,* Vol. 131, Nov. 15, 1935, pages 803-804. The form in which coal and coke, the largest single constituents in the production of iron and steel, are used is analyzed. The bulk of the coal used in iron and steel works is applied in the form of producer gas and only about 80% of the heat value in the producer coal reaches its objective, whereas blast furnace gas shows no comparable loss. The heat consumption in the coke ovens, blast furnace, open hearths, rolling mills and power stations is discussed in detail and distribution and control of gas described. Ha (6)

Recent Electric Furnace Developments in Europe. D. F. Campbell. *Electrical Engineering,* Vol. 54, Oct. 1935, pages 1048-1050. Describes induction melting, high frequency and resistance furnaces of recent design and practice. Ha (6)

Special Ovens Designed for Baking Various Metal Finishes. F. H. Faber. *Steel,* Vol. 97, Nov. 25, 1935, pages 30-32. Brief description of 4 installations. These are an A-type continuous conveyor oven for baking finish on steel barrels, which is entirely suspended from ceiling and has an external direct-fired gas heater; oven for processing wrinkle finish on grave vaults, heated with a direct oil burner, externally mounted; gas-fired, multipass, continuous conveyor oven for automatic dipping, draining, and baking of finish on small parts for automobiles; and slat-conveyor tunnel oven for drying lacquered corrugated steel sheets, with external steam heating system. MS (6)

Industrial Propane Is Used for Many Different Purposes at Steel Foundry. W. Z. Friend & E. A. Jamison. *Steel,* Vol. 97, Sept. 23, 1935, pages 56, 58. General Steel Casting Corp., Eddystone, Pa., uses oxy-C_3H_8 torches for cutting risers. Industrial C_3H_8 is used for heating 2-section, insulated, sheet steel oven for baking cores and aging small molds; mold drying; firing car-bottom annealing furnace; preheating 6-ton electric steel melting furnace and maintaining neutral atmosphere and supplying heat during operation; firing high-temperature oven furnace used for repairing high-speed tools and for heating bar stock for forging; oven-type annealing furnace; forge furnace; soft metal furnace used for oil tempering; salt bath; torch brazing; pilot lights for heating powdered coal burners under plant steam-boilers; office building steam-boiler; and cafeteria heating and cooking equipment. MS (6)

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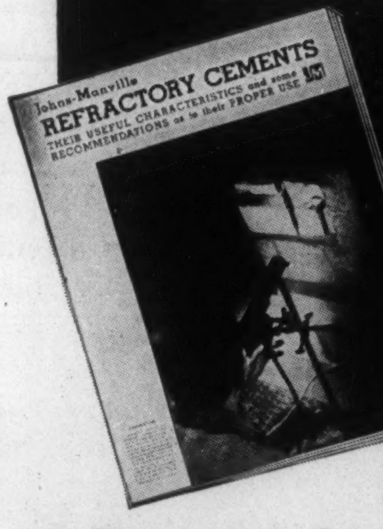
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7. JOINING

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

End-to-End Welding of Main Line Rails by the Resistance Method. E. Rietsch & A. C. Croskell. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 339-347. A machine has been developed in Germany for the resistance welding of rails. Rails welded in this machine are now being put in service in Egypt. Influence of welding on the properties of 0.45% C rails is discussed. Use of welded rails throughout the world is reviewed. It is claimed that the observed expansion of welded rails due to temperature change is about half of the theoretical value. JLG (7b)

Development and Use of Electrodes in Arc Welding (Entwicklung und Verwendung der Elektroden in der Lichtbogenschweissung). W. Strelow. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Sept. 7, 1935, pages 1080-1084. The characteristics of the arc as means for welding, and the properties of welds with bare and covered electrodes are discussed. The covered electrode although generally recognized to be superior is not always the most economical if used where a bare electrode would answer the purpose. The electrode should always be selected by the demands on the properties of the weld in order to fulfill the requirements of a given case with the least possible means and expense, i.e. most economically. Ha (7b)

Heat Effect of the Oxy-Acetylene Flame Under Different Escape Velocities of the Gas Mixture (Wärmewirkung der Azetylen-Sauerstoff-Flamme bei verschiedenen Ausströmungsgeschwindigkeiten des Brenngasgemisches). E. Streb & H. Kemper. *Autogene Metallbearbeitung,* Vol. 28, Sept. 1, 1935, pages 262-265. It was investigated whether and to what degree it would be possible to increase the heat effect of the oxy-acetylene flame by an increase of the escaping velocity of the mixture O_2-C_2H_2. The most favorable velocity was found to be 220 m./sec. The experiments are described in full. Ha (7b)

Welding in the Building Industry. William Spraragen. *Industrial & Engineering Chemistry,* Vol. 27, Oct. 1935, pages 1137-1138. The advances in welding are briefly cited. Stress is placed on the need of designing for welding in order to obtain maximum economies MEH (7b)

Electric Arc Welding and Its Applications: III. M. Maurice Lebrun. *Welding Journal,* Vol. 32, Aug. 1935, pages 230-233, 246. Discussion and photographs of magnetographic methods of weld testing which according to author confirm the X-ray findings for the welds. Results of tensile and fatigue tests by Kjellberg for parent and welded metal are reported by the author. WB (7b)

Fabrication of Welded Pressure Vessels in 1935. R. Kraus. *Industry & Welding,* Vol. 6, Mar. 1935, pages 25-27. The different techniques now preferably used, advantages of coated electrodes, reducing residual stresses and the rules in force governing welding of high pressure vessels are discussed quite generally. Ha (7b)

Expansion and Contraction in Welds. R. Kraus. *Industry & Welding,* Vol. 6, Feb. 1935, pages 26-32. Arrangement of welds and proper procedure to minimize building up of weld stresses and relieving them by annealing at 1000°-1100° F. are discussed. Ha (7b)

Welding White Metal and Zinc Alloy Die Castings. V. L. Sage. *Industry & Welding,* Vol. 6, Aug. 1935, pages 22-23. A small tip and a soft carburizing flame about 2″ long are preferably used for this purpose; the broken parts are heated until small beads appear when the filler rod is applied. Procedure is described in full. Ha (7b)

Steel Castings in Welded Structures. C. Tolan, Jr. *Product Engineering,* Vol. 6, Oct. 1935, pages 377-378. The advantageous use of combining steel castings with welded structures, as in crank cases, foundations, is pointed out. The composition of a straight C steel in such connection is best of 0.17-0.25% C, 0.5-0.8% Mn, 0.25-0.40% Si, 0.06% max. P and the same for S. A stress-relieving heat treatment at 1200°-1250° F. or a full annealing at 1600°-1650° F. is to be applied after welding. Tensile strength of 60,000-75,000 lbs./in.^{2} and a Brinell hardness of 115-160 are obtained. Several examples are described. Ha (7b)

Welding of Wires of Nickel-Chromium and High Heat Resisting Alloys by Condenser Discharge (Schweissung von Drähten aus Chromnickel und hitzebeständigen Legierungen mittels Kondensatorentladung). J. Wrana. *Elektrotechnische Zeitschrift,* Vol. 56, Sept. 5, 1935, pages 991-993. Condenser discharges produce very satisfactory welds in materials like Cr-Ni alloys, Megapyr, Kanthal, both in the shape of wire and strip. The derivation of the electrical constants of the circuit to supply sufficient energy is given. Ha (7b)

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Welded Plate Meets New Machine Problems. J. E. Wells. *Industry & Welding Quarterly,* third quarter 1935, pages 96-97. Illustrates welded manufacture of special high production machinery. Ha (7b)

Reliability of Aircraft Welds. N. F. Ward. *Transactions American Society of Mechanical Engineers,* Vol. 57, Oct. 1935, pages 389-394. The effects of fusion welding upon the dependability of structures in aircraft was investigated. Localized heat, especially in arc welding, and temperature stresses can seriously impair the soundness of the weld. Application of heat unnecessarily near critical sections should be avoided. Welding of telescoped tubes or fishmouth is preferable to butt welded tubes on account of the added stiffness and stability afforded in the joint. Deposition of relatively smooth concave weld beads is practiced where vibration is a predominant consideration. As the structural members in aircraft fuselages are subject to tension, compression and bending loads of various intensity, tube size and plate thickness must be calculated for one or several predominant stresses and the material selected accordingly. Ha (7b)

Some Comments on Welding Procedure. H. N. Wallin. *Welding Engineer,* Vol. 20, Oct. 1935, pages 29-31. Cause and effects of shrinkage, stresses, size of electrodes, and principles of sequence welding, i.e., the proper sequence of steps in the welding process, are discussed. Ha (7b)

Factors to Consider when Designing Parts for Projection or Spot Welds. A. M. Wallace. *Machine Design,* Vol. 7, Aug. 1935, pages 26-29. Method and advantages of spot and projection welding, weldability of some 500 metals and metal combinations by spot welding (chart) and accomplishments of both welding processes in practice. WH (7b)

Electric Arc Welding in Shipbuilding. E. F. Spanner. *Welder,* Vol. 7, Sept. 1935, pages 680-684. The advantages of the newly devised "truss-weld" or "open-frame" weld system are discussed; according to recent tests, open frames were able to sustain a load 53% in excess of that held by a riveted frame of the same weight and 30% more than an ordinary welded frame of the same dimensions; besides, the open frame showed enduring flexibility, under heavy stress. The hull of the ship was 30% lighter. The welding procedure is described in detail and illustrated by examples of design details. Ha (7b)

Welding in Marine Engineering. E. F. Spanner. *Symposium on Welding of Iron & Steel,* Organized by Iron & Steel Institute, May 2-3, 1935, 7 pages. Discusses suitability of welded structures in marine engineering. Welded structures in place of castings permit weight saving. JLG (7b)

Welding as an Aid to the Making of Quality Steel Castings. C. M. Underwood & E. J. Ash. *Welding Engineer,* Vol. 20, Sept. 1935, pages 60-65. Repairing steel castings by welding, procedures employed in the Naval Gun Factory and several cases are described to show that extensive reclaiming of bad castings is possible. Ha (7b)

Welding Cast Iron. A. L. Tucker. *Industry & Welding,* Vol. 6, Apr. 1935, pages 18-19. Best procedure in welding long seams on broken cast Fe parts is described. Ha (7b)

Some Notes on Preheating and Contraction and Expansion. F. E. Totten. *Welding Engineer,* Vol. 20, Oct. 1935, pages 22-23. Equipment and procedure for welding, avoiding disadvantages or making use of contraction and expansion are illustrated by examples. Ha (7b)

Welded Bridge Girders of 52 m. Span (Geschweisste Blechträger von 52 m. Stützweite im Zuge des Rügendammes). A. Seeger. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Sept. 28, 1935, pages 1173-1175. Details of design and welding methods. The material was structural steel St 37; the double-V of the weld seam had an especially large angle which, as previous experiments had proved, gave a greater strength than the usual smaller angles. Ha (7b)

Residual Stress Effects in Static Tension Specimens. R. E. Jamieson. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 16-21; *Iron Age,* Vol. 136, Sept. 26, 1935, pages 78-79, 84, 90, 92. Measurements were made on plates which were cut into strips after welding and pulled in tensile testing machine using Martens extensometer for small strains and scale and pointer for elongation after the yield point. Values were determined for shrinkage during welding and residual stress and the values are plotted for the plates welded. Curves are given for the tests of tensile properties on loading and unloading showing that on reloading the specimens the original curves are not retraced because residual stress added to stress applied during test has been above yield point. The yield point on first application of the load is higher than that of the plate without the weld but the ductility suffers to some extent. The average reduction of ultimate strength due to the weld is about 9%. VSP + WB (7b)

Practical Hints for Autogenous Welding of Aluminum (Praktische Winke für die Autogenschweissung an Herdschiffen aus Aluminium). M. Maier. *Autogene Metallbearbeitung,* Vol. 28, Sept. 1, 1935, pages 265-266. The material to be welded (Al sheets, etc.) and the welding rod must be the purest possible. If the purity of the latter is doubtful it should be tested in NaOH; after immersion for some time the wire should be silver-white or must not be used. Procedure is described. Ha (7b)

Composition of Deposited Metal in Arc Welds (Composizione del metallo di apporto nella saldatura ad arco). L. Losana & N. Jarach. *La Metallurgia Italiana,* Vol. 27, Aug. 1935, pages 563-575. Distribution of Mn, Si and C between metal and slag in arc-welding has been studied. When Mn and Si are held constant, the C-content in the deposited metal does not increase even with large additions of C in the filler metal. However, increasing either the Mn or Si causes a corresponding increase in C, up to a certain limit, i.e. about 0.6%. It has not been possible to increase the C above 0.6% even when large additions of Mn and Si were made. The partition of Ni between metal and slag depends on the amount of Mn present. With Mn absent, the Ni is utilized almost completely, but decreases as the Mn increases. On the other hand, Cr increases with increasing Mn content. The partition of Cr between metal and slag also depends on the C-content. When both Ni and Cr are present, each assists the other, making it possible to get very high Cr and Ni contents in the deposited metal, the C remaining low. AWC (7b)

Handling Distortion in Maintenance Welding Problems. George W. Hettrick. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 11-15; *Industry & Welding,* Vol. 7, Oct. 1935, pages 14-15. Discussion of repair problems with respect to preparation of the material, preheating deposition of the metal and cooling. The various jobs are illustrated by photographs of the pieces before and after welding. Ha + WB (7b)

Welding Copper, Copper Alloys, Bronze and Red Brass. Clinton E. Swift. *Industry & Welding,* Vol. 6, Mar. 1935, pages 6-9, 38-39. See "High Voltage Carbon Arc Welding of Copper and Its Alloys," *Metals & Alloys,* Vol. 6, Apr. 1935, page MA 154L/2. Ha (7b)

Fabricating All-Welded Overhead Crane. W. G. Wehr. *Industry & Welding,* Vol. 6, Mar. 1935, pages 14-16. Describes procedure. Ha (7b)

Behavior of Fillet Welds when Subjected to Bending Stresses. Norman G. Schreiner. *Welding Journal,* N. Y., Supplement, Vol. 14, Sept. 1935, pages 1-16. Combined shearing and bending stresses were studied, tensile properties and specific gravities as well as pure bending stresses. The strength of the fillets for lightly coated and heavily coated electrode were investigated. Present design gives a factor of safety of about 7. The use of heavily coated rod increases the bending resistance in about the same proportion as the tensile strength is increased. Test data are given in tables and construction of test pieces shown in diagrams and photographs. Types of failures are shown. Chemical analysis of electrodes and deposit given for a number of electrodes. WB (7b)

Controlling Welding in the Structural-Steel Fabricating Shop. R. E. Kinkead. *Welding Engineer,* Vol. 20, Oct. 1935, pages 24-25. A general discussion of welding practices and the necessity for setting standards in the fabricating shop. Ha (7b)

Preventing Distortion of Longitudinal Seams in Welded Pressure Vessels. J. T. Phillips. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 26-27. The practice of Foster Wheeler Corp. in fabricating boiler drums is to have the shell slightly out of round at the seam before starting the weld. This is done with bars exerting pressure by means of hydraulic jacks, the bars being removed on completion of weld. A uniform diameter of the drums results thus removing necessity for subsequent hot or cold rolling to obtain roundness. WB (7b)

Some Notes on the Reclamation of Grey-iron Automobile Castings by Welding. Vincent C. Faulkner. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 619-620. Describes practical use in reclamation of automotive castings. Both electric and oxy-acetylene welding on preheated castings is used. JLG (7b)

Metallurgical Fundamentals of High-speed, High-quality Autogenous Welding. A. B. Kinzel. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 419-425; *Welding Journal,* N. Y., Vol. 14, Aug. 1935, pages 18-20. Shows how to obtain mechanical soundness in welding with acetylene flame. Discusses heat treatment of welds. JLG + WB (7b)

Cutting Structural Steel. J. H. Zimmerman. *Industry & Welding,* Vol. 7, Nov. 1935, pages 15-19. Comparative studies of the effects on metals of the cutting of metal by the friction saw, the shear, by hand and by machine flame cutting showed that the disturbance of the hardness and the structure of the structural steel plate tested is less severe in flame cutting than in either shearing or friction sawing. Machine-flame cutting does not appreciably affect the toughness of the metal adjacent to the cut surface; hand-torch cutting definitely improves the toughness of this metal, and shearing and friction sawing decrease the toughness slightly. Ductility of the structural plate as determined by cold-bend test, is less seriously affected by hand-torch cutting than by shearing or friction sawing, and machine cutting may even be beneficial in this respect. Ha (7b) 1

Design and Tests of Butt-welded Joints. Gilbert Roberts. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 161-171. Gives properties of butt-welded joints of different types made by metallic-arc welding. Even unsound joints had a strength of 85 or 90% that of the plate being welded. The included angle between the sides should not be less than 40° unless special precautions in welding are observed. JLG (7b) 2

A Study of the Thermally Disturbed Areas in Carbon Steels. A. T. Roberts. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 531-537. Describes microscopic and hardness survey of areas adjacent to welds. JLG (7b)

Fatigue of Welds. A. M. Roberts. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 831-841. Gives data on fatigue tests of different types of welds. The general conclusions regarding fatigue strength of welds are considered to be encouraging. 26 references. JLG (7b)

Influence of Oxygen and Nitrogen on the Properties of Arc Deposited Metal. L. Reeve. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 517-529. Gives data on the influence of electrode covering on absorption of O and N. Effects of non-metallics on properties of welds are discussed. Results of the author's special vacuum-fusion method applied to weld-deposited metal are given. 20 references. JLG (7b) 4

The Joint-Welding of Alloy Steels. F. Rapatz. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 507-516. Discusses welding of both low- and high-alloy steels. C steels containing over 0.40% C do not have sufficient ductility after welding, but some alloy steels of comparable strength have a good ductility after welding. For welding high-strength alloy steels coated electrodes should be used. JLG (7b)

A New Method for the Investigation of the Transfer of Material Through the Welding Arc. J. Sack. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 553-559. Reviews methods that have been used for studying transfer. Results obtained by radiography are then described. With intensifying screens good pictures were obtained at 12½/sec. JLG (7b) 5

Welding of Everdur. C. E. Swift. *Industry & Welding,* Vol. 7, Nov. 1935, pages 36-43. Everdur in sheets has a composition of 96% Cu, 1% Mn, 3% Si, and in tubes 98.25% Cu, 0.25% Mn and 1.50% Si; it can easily be welded. The best procedures to apply in arc and oxy-acetylene welding for plates of different thicknesses are given in tables. When welding Everdur to steel the metallic or carbon arc is employed. Ha (7b) 6

Welding Rods for the Acetylene Welding of Steel. E. Streb & H. Kemper. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 573-591. Reasons for different results obtained with welding rods of same chemical composition are discussed, and methods are explained for the avoidance of pore formation. Results of tests on different welds are given. Value of tensile impact is discussed. Rods suitable for welding of high-strength constructional steels are described. JLG (7b)

Automatic Arc Welding of Iron and Steel. J. E. Sticpewich. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 181-188. Discusses field of automatic welding and procedure for this type of welding. JLG (7b) 7

The X-Ray Examination of Welds. R. A. Stephen. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 915-923. Discusses radiography of welds and gives directions for use on typical joints. JLG (7b)

Welding in British Railways (Mechanical Engineering). W. A. Stanier. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 349-356. Lists uses of welding for repairing and building new equipment. Cu fire boxes are welded. JLG (7b) 8

Welding Research in the United States. W. Spraragen. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 251-261. The importance of literature research is stressed. Welding research being undertaken by firms and government institutions in the United States is discussed. JLG (7b) 9

Thermit Fells Skyride Tower in Forty-Two Seconds. Merritt L. Smith. *Welding Journal,* N. Y., Vol. 14, Oct. 1935, pages 7, 19. Destruction of tower at Chicago Exposition grounds described. WB (7b)

The Nature of Fluxes and Their Effect on Weld Metal. T. C. R. Shepherd & M. R. Moritz. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 561-567. Outlines the different types of fluxes used to cover arc-welding electrodes and sketches principles on which their design is based. JLG (7b) 10

Methods of Ensuring Satisfactory Electric Welding. T. C. R. Shepherd & S. W. Carpenter. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 161-179. Survey of methods and technique for producing satisfactory electric welds. JLG (7b)

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The Electric Welding of Chain by the Low Voltage Process. T. F. Holden. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 507-511; *Welding Journal*, British, Vol. 32, Sept. 1935, pages 270-272. Describes manufacture of welded chain in typical semi-automatic equipment. JLG + WB (7b)

Some Aspects of Metallic Arc Welding. Herbert Harris. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 359-362. Discussion of some of the metallurgical features of arc welding. See also *Metals & Alloys*, Vol. 6, Aug. 1935, page MA 325L/9. JLG (7b)

The Welding of Special Steels. W. H. Hatfield. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 363-371; *Sheet Metal Industries*, Vol. 9, June 1935, pages 393-394; Aug. 1935, pages 520-521; *Iron & Steel Industry*, Vol. 8, May 1935, pages 311-313. Considers problems resulting from both low- and high-alloy steels. Each type of steel brings its own problem, and the extended use of welding demands careful exploration of the metallurgical as well as the practical procedure in each case. JLG + AWM + CEJ (7b)

Welding Bronze to Steel. Charles H. Jennings. *Electric Journal*, Vol. 32, Aug. 1935, pages 317-318. Metallic-arc or carbon process can be used but the metallic arc process is preferred. Two important points are: (1) the 2 metals must be brazed and not fused; (2) the deposited bronze must be cooled quickly to prevent porosity as a result of liquation or separation of component metals. Welding procedure and joint design are explained. CBJ (7b)

The Manufacture of Steel Tubes by Electrical Resistance Welding. J. W. Jenkin. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 273-276. Describes process. Properties of the steel are not affected by the welding. JLG (7b)

The Development and Future of Autogenous Welding. T. McLean Jasper. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 267-272. Reviews development of welding, properties of welds made by present-day methods, and forecasts future of welding. JLG (7b)

Electric Arc Welding in Modern Engineering. F. Janovsky. *Journal South African Institution of Engineers*, Vol. 34, Sept. 1935, pages 35-45. The d.c. arc is steadier than the a.c. arc and d.c. welding requires less skillful operation, and permits the use of bare or dipped electrodes. Many types of applications of arc welding are illustrated. WHB (7b)

A Comparative Study of Direct and Alternating Currents in Arc Welding. J. Legrand. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 119-132. Reports study of characteristics of a.c. and d.c. arcs. Concludes that a.c. arc is preferable for welding. JLG (7b)

Current Researches on Welds in Relation to Boilers and Other Pressure Vessels. F. C. Lea. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 277-287. Describes research on properties of welds that is being carried out by Welding Research Committee of the Institution of Mechanical Engineers (British). JLG (7b)

The Development of Resistance Welding in France. J. E. Languepin. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 227-236. Discussion of equipment used in France. JLG (7b)

The Development of the Welded Plate Girder. Eric Lang. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 127-132. Discusses design of welded plate girders. JLG (7b)

Metallurgy of the Welding Electrode in the Arc. J. F. Lincoln. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 437-443. Discusses metallurgy of arc welding and superior results obtained by welding with covered rods. JLG (7b)

The Fusion Welding of Stainless Irons and Steels. M. R. Moritz. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 445-452. Discusses application of arc and atomic-H process to welding of stainless Fe and steels. These 2 processes constitute the fastest and soundest methods for welding Cr-containing materials. JLG (7b)

Workshop Practice in Structural Steel Welding. P. Mitchell & H. Martin. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 139-154. Discusses design and welding technique useful in welding structural steel. JLG (7b)

The Industrial Possibilities of Oxy-Acetylene Welding. R. Meslier. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 247-249. Compares relative advantages of oxy-acetylene and arc welding. Concludes that the former has a varied range of industrial applications that will expand in the future. JLG (7b)

Arc Welding Builds Longer Life into Pulp and Paper Mill Equipment. R. R. Kondal. *Paper Trade Journal*, Vol. 101, Oct. 31, 1935, pages 50-52. Arc welded construction resists corrosion and thereby increases the life of the digester. CBJ (7b)

Welding Modern Houses. C. D. McFalls. *Industry & Welding*, Vol. 7, Nov. 1935, pages 20, 30. Extensive use of prefabricated welded parts for houses is commented on. Ha (7b)

Welded Steel Bridges in Victoria, Australia. W. T. B. McCormack. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 133-141. Describes the welded bridges that have been erected in the State of Victoria. JLG (7b)

Some Theoretical Problems Relating to Resistance Welding. Marcel Mathieu. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 237-246. Gives theoretical treatment of various problems of resistance welding. JLG (7b)

Problems in the Application of Welding to Structural Steelwork. Fausto Masi. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 153-160. Deals with design features of welded structural work. JLG (7b)

The Application of Welding in the Construction of Rigid Frames with Solid Webs for Steel Structures (Particularly Roofed Structures). H. Maier-Leibnitz. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 143-152. Describes use of the above construction in Germany. 9 references. JLG (7b)

New System of Welded Ship Construction. R. D. MacMillen. *Welding Journal*, N. Y., Vol. 14, Oct. 1935, pages 11-13. A Diesel propelled oil carrier is being welded according to patented system of Johannes Kjekstad for all-weld ship construction. The design type is called "free flow frame system," and has been tested in Norway, showing 27% higher structural efficiency against deflection, 14% less permanent set and is capable of sustaining 53% greater load than riveted frame of same weight or 30% greater than ordinary welded frame. The design is characterized by the separation of strength members from the shell for a short distance, but to which they are rigidly attached by means of lugs. WB (7b)

Repairing Zinc Base Die Castings by Oxy-Acetylene Welding. C. W. Mace. *Metal Industry*, London, Vol. 46, May 3, 1935, pages 477-479; May 17, 1935, pages 528-529. A description of the technique and type of welding-rod developed to permit the type of welding indicated by the title. After discussing the use of Zn base die castings, their compositions and methods for identifying them, the author outlines the welding procedure. In this are described methods for setting up castings to be repaired, molding necessary for the build-up, flame adjustment, and movement of the welding rod. Consideration is given to the formation of a surface film and methods for its removal. The strength of the weld metal is also discussed. HBG (7b)

A Contribution to the Study of Nitrogen in Its Relation to Welding. Albert M. Portevin & D. Séférian. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 483-506. Literature on N in steel is reviewed. Methods for determination of N are given. Experiments showed that bare Fe in the arc fused to give an alloy with 0.15 to 0.20% N. Studies of the influence of surrounding media lead to the conclusion that nitrides are formed by the action of atomic N resulting from decomposition of N_2 in the arc. The Fe-N diagram was investigated and the position of the solvus shifted towards the Fe side. Data on the influence of N on aging are given. 50 references. JLG (7b)

Accidents Due to Defects in Welded Apparatus and Plant. F. E. Pollard. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 825-829. Deals with failures due to defective links in wrought-Fe chain and with failures in unfired pressure-welded vessels having fusion-welded joints. JLG (7b)

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The Influence of Standardisation in the Development of Welding. J. O. COOKE. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 737-743. An attempt is made to indicate the wide field over which standardization or the establishment of standards is being effected in the development of the industry in England. JLG (7b) 6

The Technical and Metallurgical Aspects of Flame Cutting. C. G. BAINBRIDGE & E. J. CLARKE. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 321-331. Section I, by Bainbridge, reviews the gas cutting process for preparation of welding edges. Section II, by Clarke, reports results of examination of arc welds made on flame-cut surfaces. JLG (7b)

The Electrically-welded Oil Barge "Comor." D. E. BALDWIN. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 175-186. Describes barge and its method of construction. A riveted barge, under the conditions prevailing in Australia, would have cost at least 15% more. JLG (7b) 7

Arc Welding in Highway Bridges as Carried Out by the Public Works Department, Tasmania. G. D. BALSILLE. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 43-46. Describes structures. JLG (7b)

8 **The Low-Temperature Annealing of Welded Mild-Steel Structures to Relieve Internal Stresses.** L. E. BENSON & H. ALLISON. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 19-27. Discusses effect of temperature on stress relief and then gives data to show effectiveness of different treatments. JLG (7b)

The X-Ray Examination of Welded Connections. R. BERNHARD. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 677-678. Discusses German practice. JLG (7b)

9 **Factors Affecting the Properties of Metallic-Arc Weld-Metal.** L. C. BIBBER. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 29-37. Discusses the various factors that influence quality of the weld. JLG (7b)

Relations between the Design and Fatigue Strength of Welded Structural Joints. O. BONDY. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 679-687. Discusses fatigue strength of welds and concludes that forms of welded connections for dynamically loaded structures, especially bridges, call for continued development on a basis of the results of fatigue tests. JLG (7b)

10

The Present Position of Arc-Welding in France. J. BRILLIÉ. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 213-222. A discussion of some of the technical and economic features of welding. JLG (7b)

The Deposition of Wear-Resisting Steel for Railway Track Maintenance. C. R. DÉGLON. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 353-358. Discusses use of welding in building up rails and crossings. JLG (7b)

Automatic Welding. S. W. CARPENTER & A. L. GUEST. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 537-548. Discussion of equipment for arc and atomic-H welding. JLG (7b)

Procedure Control of Electric Arc Welding in Australia. W. D. CHAPMAN. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 199-204. Deals with requirements for welds and ways of specifying welding technique. JLG (7b)

The Stress Analysis of Fusion Joints. E. G. COKER. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 703-713. Discussion of stress concentrations produced by welds or by holes. An appendix by A. E. H. LOVE gives mathematical analysis of stress concentration about a cavity in a tensile member. JLG (7b)

Welding on to a Member which Is Already Stressed. H. W. COLAM, J. D. WATSON & H. LINGARD. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 715-735. Gives results of tests on welding structures of different types. Results show that when welding is done on a member in compression part of the member, in effect, goes out of business. JLG (7b)

Welding Operations on the Ford V-8. DAVID P. CONNERY. *Welding Journal,* N. Y., Vol. 14, Oct. 1935, pages 8-10. The new Ford is turned out with 3415 welds and weld applications are increasing. Some of the welding operations are described, most of them are completely automatic, and require no skill on the part of the operator. WB (7b)

The Factors of Rod, Work, and Operative in Welding. E. A. ATKINS. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 317-320. General discussion of welding. JLG (7b)

Bridge Welding Practice of the Railway Construction Branch, Victoria, Australia. A. S. ATKINSON & C. J. O'MALLEY. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 23-29. Discusses design features of welded railway bridges. JLG (7b)

Maintenance Welding on a Production Basis. *Canadian Machinery,* Vol. 46, Oct. 1935, pages 37-41. Information is given as supplied by Linde Air Products Co. as to production set-up and details for repair of spinning caps for wool conversion into thread by bronze welding. Reclamation of caps costs about 7c against price of new cap of 60-70c. WB (7b)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Surface Coloring of Metals (Oberflächenfärbung der Metalle). Georg Buchner. *Chemiker-Zeitung,* Vol. 59, Oct. 16, 1935, pages 841-843. Coloring processes are divided into several groups: a. Metal deposited without a current, as by dipping Zn or Fe in Cu solutions; b. Conversion of the surface to a colored metallic compound, as in the oxidation of Fe and steel by heat, oxidation of Cu in air or O_2, treatment of Cu in various solutions; c. Deposition on the metal surface followed by a reducing or other reaction in a solution, as in some Cu coloring solutions; d. Adsorption of colloidal particles from a liquid resulting in formation of a continuous thin layer; e. Cathodic and anodic processes. Details are not given. CEM (8)

Metallic Protective Coatings. I. G. Slater. *Sheet Metal Industries,* Vol. 9, Apr. 1935, page 199. General discussion of metallic and non-metallic coatings. AWM (8)

Finishing Electric Heaters. Howard Burns. *Industrial Finishing,* Vol. 10, July 1934, pages 15-16. A short description of the cleaning, lacquer-spraying and drying processes on steel and Al parts of electric water and air heaters. JN (8)

Finish Foundation for Bare and Plated Steel. George A. Endom. *Industrial Finishing,* Vol. 11, Mar. 1935, pages 9-11; Apr. 1935, pages 22-24. Discusses cleaning solutions and coatings employing red Fe oxide oil base, lead chromate oil base and zinc chromate lacquer as primers. Gives results of exposure tests showing effectiveness of metal cleaning and durability of finish coatings. VSP (8)

Finishing, Cleaning and Refinishing Steel Drums. Albert F. Byers. *Industrial Finishing,* Vol. 11, Oct. 1935, pages 5-7, 26. Describes general practice. VSP (8)

Developments During 1934. *Industrial Finishing,* Vol. 11, Jan. 1935, pages 12-24, 26, 28, 33-34, 36, 38. Review of improvements in the finishing of materials. Includes metal, rust- and heat-resisting finishes, finishes for Zn, galvanized and Al surfaces and metal cleaners. VSP (8)

The Finishing of Zinc Alloy Diecastings and Rolled Zinc. Imperial Smelting Corporation Ltd. 95 Gresham St., London, E. C. 2., Sept. 1935, 12 pages. Recommendations for polishing, cleaning, pickling, plating and rinsing of Zn. Direct nickeling of Zn for an undercoat for Cr is preferred, from a $NiSO_4$, Na_2SO_4, NH_4Cl, H_3BO_3 solution containing respectively 12, 2, 2 and 1-½ oz./gal. of these constituents, operated at a pH of about 6, at 75° F. Bright Ni deposits, obtained by the addition of a little $CdSO_4$, are smooth, bright, but highly stressed and brittle. They are not advocated as undercoat for Cr. HWG (8)

Beauty and Permanence of Finish Combined by Etching Process. A. H. Allen. *Steel,* Vol. 97, Nov. 11, 1935, pages 32-35. Describes procedure of Crowe Name Plate & Mfg. Co., Chicago, in etching name-plates and decorative metal panels. Sheets are first prepared with the desired finish which later will be high lights of etched plates. Standard photolithographing process is used for transferring designs onto cleaned sheets from Zn printing plates. Blanks, with portions to remain unetched protected by a baked coating of resist powder, are lowered on racks into etching solutions, air agitated. Solutions used are HNO_3 for plain steel; $FeCl_3$ for stainless steel, brass, and bronze; HF and HCl for Al; and $Na_2Cr_2O_7$ and H_2SO_4 for Zn. Depth of etching varies from 0.001″ to 0.003″. The etched sheets are washed and dried with sawdust. Correct finish is then applied to background to produce desired contrast with high lights, resist is removed from naphtha or benzine, and sheets are cleaned, inspected, lacquered, and then subjected to the necessary machining operations. Other methods of producing name-plates are coin embossing, surface finishing without relief, and lithographing. MS (8)

■ 8a. Pickling ■

The Effect of Various Acids on Cold Rolled Steel. E. T. Candee. *Monthly Review American Electroplaters' Society,* Vol. 22, Aug. 1935, pages 23-37. Experiments were conducted with steel strip (17/32″ x .020″, C .12, Mn .44, Si .11%) which was to be electroplated with Zn and then formed into flexible tubing. Embrittlement must therefore be avoided in pickling. Samples were pickled in HCl, H_2SO_4, and HNO_3 under various conditions; pickling period ranging from 1-15 minutes, temperatures 70 and 140° F., acid concentrations 3, 5, and 10% by weight. Degree of embrittlement was indicated by number of bends before first crack appeared (in Amsler Bend Tester with #2 jaws, radius .078″). Results: H_2SO_4, 3, 5, and 10%, cold, slight embrittlement; 5 and 10%, hot, ductility was seriously impaired but was regained after 7 days storage. HCl, 3 and 5%, at 140° F. embrittle but not cold. The embrittlement disappears if pickling time has not been over 5 minutes. HNO_3 3, 5, and 10%, hot or cold, does not embrittle. With HNO_3, and under some conditions with other 2 acids, greater ductility was found after pickling (and storing) than before pickling. Explanation offered in discussion is that sharp edges of small initial cracks are rounded off by the acid and number of bends to failure thus increased. A patent electrolytic bright dip (40° Bé. H_2SO_4, 80° F., 100 amps./ft.^{2}) also studied showed no embrittling effect. Oxide films left on the steel after pickling, if excessive, impair the adhesion of subsequent electroplating. Extent of film left on steel after pickling treatments mentioned was measured by applying a drop of M/20 $Cu(NO_3)_2$ for one minute. Formation of bright metallic Cu indicates no oxide film is present; dark brown Cu deposit indicates discontinuous film; and absence of Cu deposit indicates continuous oxide film. Practically all samples pickled in HCl showed no oxide film. All H_2SO_4 pickled samples showed a discontinuous film. All HNO_3 pickled samples showed a continuous film. Samples after electrolytic bright dip showed a discontinuous film, which type of film has been found to afford sufficient adhesion for the Zn plating to withstand the forming operations. GBH (8a)

Wooden Pickling Tanks. Paul W. Bennington. *Steel,* Vol. 97, Dec. 2, 1935, pages 30-34. Discusses principles of design and construction. Best lumber for this service is dense, heavy, pitchy, close grained, long-leaf, yellow pine. Cypress and Douglas fir also are used. Tanks should have bare compression joints with no slip tongues, white lead or any other sealing compound in the joints. Bolts or rods should be sufficient in number and of such area at root of the thread so that, with the given yield strength of the metal, pressure produced will be greater than 25,000-40,000 lbs./in.^{2}, depending upon type of joint. Presents table giving theoretical number of rods required for all sizes of tanks for parallel timber joint. Monel metal and Al bronzes generally are favored for tie-rods. Alloys high in Cu are more susceptible to corrosion by concentration cell action than those high in Ni. Tightening up of tank as it shrinks is facilitated by placing end timbers vertically so that they do not cross grain with bottom timbers and holding tops by a cleat. Ends of rectangular tanks should be mortised into sides and bottom. Densest and strongest timbers should be placed on edges where washers bear. There should be wide chines on the bottom at the sides. Side and bottom bolts should be as near to each other as possible. Nuts and washers should be placed on face of timber and covered with counterbored coping secured by dowels. Long tanks, exceeding 3 ft. in depth, should have sides reinforced against bowing in. On wide tanks it is well to have horizontal bottom cleats under ends with a slight upward arch. MS (8a)

Organic Inhibitors for Iron and Steel. Harold A. Levey. *Chemical Industries,* Vol. 37, Aug. 1935, pages 124-126. Results by other workers together with results of a few tests to determine the relation between molecular structure and inhibiting action are given. 11 references. RAW (8a)

Potential Oscillations of Iron in Nitric Acid. II. (Ueber die Potentialschwingungen des Eisens in Saltpetersaüre. II). M. Karschulin. *Zeitschrift für Elektrochemie,* Vol. 41, Sept. 1935, pages 664-667. When Armco iron is placed in a 30 or 40% HNO_3-H_2O solution a thin red brown layer is formed in the solution at the metallic surface. The film is thinner in solutions of low concentration. The absorption spectrum of this brown film of liquid is identical with that of $Fe[NO](NO_3)_2$. In the low-concentration acid, a finely etched gray surface is formed while with the high-concentration acid the etched surface has a bright metallic luster. The rate at which the metal goes into solution is not constant as evidenced by the periodic formation of gas. The periodic solution of Cu in HNO_3-HCl mixtures behaves similarly in the formation of such a complex. HAS (8a)

Reclaiming of Copper from Pickling Waste Waters in Metal Industries (Kupferrückgewinnung aus den Beizereiabwässern der Metallwarenfabriken). A. Plinke. *Chemische Apparatur,* Vol. 22, Oct. 10, 1935, page 176. Cu from the sulphate in the pickling bath is precipitated with Fe with formation of Fe sulphate. The economical advantage may be great as large plants can recover considerable amounts of Cu. An installation is described. Ha (8a)

The Use of Sodium Cyanide in a Neutralizing Bath in Pickling Sheet Iron for Enameling. E. H. Shands, G. L. Bruton & G. J. Grimes. *Journal American Ceramic Society,* Vol. 18, Oct. 1935, pages 323-324. The advantages of using equal parts of NaCN and soda ash are listed as:—(1) lengthened life of solution, (2) increased speed of neutralizing reaction due to higher degree of ionization of NaCN than Na_2CO_3, (3) more thorough penetration into the pores of the steel because all the reaction compounds, $Fe(CN)_2$, NaCl, $Na_4Fe(CN)_6$, are soluble thus no masking of the pores of the steel, can take place, (4) economy in plant operation. WB (8a)

■ 8b. Cleaning including Sand Blasting ■

Treatment of Aluminum Surfaces before Metallizing (Die Behandlung von Aluminiumflächen vor dem Metallisieren). *Oberflächentechnik,* Vol. 12, Nov. 5, 1935, page 257. Before metallizing or coloring, Al or Al alloys must be treated by sandblasting or pickling; the former is particularly favorable for metallizing. According to the grain size of the sand the following conditions should prevail:

sand	coarse	medium	fine
air pressure in kg./cm.^{2}	4-6	4-6	4-5
distance of nozzle from metal in cm.	30-50	20-35	20-35
diam. of nozzle in mm.	9-12	6-12	6-9

The nozzle should be held at an angle of 60°-90° to the metal surface. Chemical treatment with alkalies or acid produces a white, slightly rough or matte surface; a 10-20% NaOH solution of 50°-100° C. gives in 30 sec. a uniformly treated surface. After treatment the objects should not be touched by hand. A more expensive means which, however, gives a fine-grained surface, is treatment with warm, 10% Na_2CO_3 solution, or with cold solution of equal parts of saturated NaF and concentrated HNO_3 or cold solution of equal parts of 10% H_2SO_4 and 2 or 5% HF. Ha (8b)

Cleaning and Degreasing of Metallic Parts (Reinigen und Entfetten von Metallteilen). *Oberflächentechnik,* Vol. 12, Sept. 17, 1935, pages 222-223. Rules suggested and adopted by the (German) Committee of Economical Finishing Methods for cleaning and degreasing are reprinted and discussed. Ha (8b)

Preparation, by Cleaning and Degreasing, of Metallic Surfaces before Coating (De la preparation par décapage et dégraissage des surfaces métalliques avant revêtements superficiels). P. Orlowski. *Métaux,* Vol. 9, Oct. 1934, pages 498-500. Cleaning and especially degreasing of metallic surface by means of trichlorethylene are generally discussed. GTM (8b)

Metal Cleaning by Tumbling and Burnishing. N. Ransohoff. *Metal Progress,* Vol. 28, Sept. 1935, pages 57-60, 76. Describes cleaning equipment and advantages and suitability of these methods for various types of work. WLC (8b)

Sand Blasting. Robert E. Kunkler. *Metallizer,* Vol. 3, Oct. 1935, pages 6-7, 10. Effectiveness of metal spraying depends largely on proper preparation of the surface to be sprayed. Sand blasting to clean and roughen the surface is the standard method of preparation. Tabulations are given to show the rate of flow of various abrasives through different nozzle openings and air flow secured at various pressures. The quantity of air used is based entitrely upon the nozzle size and not upon the size of the sand blast machine. BWG (8b)

Electrolytic Metal Cleaning. *Synthetic & Applied Finishes,* Vol. 6, July 1935, page 83. Electrolytic cleaning solution demonstrated during a recent exhibit by the S.A.E. contained by weight percentage: $NaOH = 63\%$, $Na_3PO_4 = 29.5\%$, $Na_2SiO_3 = 7.5\%$. A current density of 50 amps./ft.^{2} was found most satisfactory. EF (8b)

Acid Wastes from Metal Finishing Shops. *Synthetic & Applied Finishes,* Vol. 6, Sept. 1935, pages 137-138. Discusses control and disposal of metal cleaning baths. EF (8b)

Descaling Heat-treated Parts. *Automobile Engineer,* Vol. 25, Nov. 1935, pages 413-414. An improved electrochemical process (Bullard-Dunn) for removing scale from heat-treated parts or forgings is described. The work forms the cathode so that the scale is lifted from the surface by the hydrogen generated in the descaling solution. At the same time a thin adherent protective metal film is deposited on the clean base metal from which the scale has been removed. This protects the exposed parts as the descaling process is continued to remove scale from remote or recessed parts and has the additional advantage that the throwing power of the solution is increased, since the flow of current is reduced or cut off from parts or projections nearest the anode. Advantages over other pickling methods with their attending chemical reactions are pointed out and the practical application of the method is described. Ha (8b)

Cleaning Metal Refrigerator Parts. M. M. Miller. *Industrial Finishing,* Vol. 11, June 1935, pages 9-11. Describes the various methods of cleaning metal refrigerator parts prior to coating. Suggests that all cleaned parts should be "tack-ragged," that is wiped with drying varnish to remove lint, dust or similar substances. VSP (8b)

■ 8c. Polishing & Grinding ■

Grinding (Das Schleifen). G. Uhlmann. *Feinmechanik & Präzision,* Vol. 43, Nov. 1935, pages 163-166. Brief historical sketch of the art of grinding. Natural grinding agents are quartz, emery and corundum; artificial grinding materials, artificial corundum, silicon carbide and several oxides. Grinding wheels and materials for finest grinding and polishing are discussed. In general, grain 50-200 is used for fine-grinding and sharpening of fine tools; grain 30-36, for grinding brass and copper, and sharpening of tools; grain 16-24, for grinding of steel, wrought and cast Fe, and for rough sharpening of machine knives and chilled cast rolls; grain 10-14, for blasting of castings and, in general, for taking off material. Mineral, ceramic and vegetable binders are used for the grinding material of which the ceramic have found widest applications in the metal industries; this binder is usually a mixture of clay, kaolin and feldspar. Ha (8c)

Grinding and Polishing of Copper, Light Metal Alloys and Tin Plate Objects (Feinschliff und Politur auf Waren aus Kupfer, Leichtmetallen und Weissblech). Rudolf Plücker. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Apr. 15, 1935, page 165. Detailed instructions. Difficulties in polishing tin plate are stressed. EF (8c)

High Grade Finishing of Metallic Surfaces (Feinstbearbeitung der Metallfläche). Rudolf Plücker. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Nov. 15, 1935, pages 478-481. Discusses various polishing methods such as rotating drums filled with sand and water, methods requiring pressure, drums containing balls and polishing agents, and polishing with hardest polishing steels, agate or hematite ("Glanzdrücken"). Finishing of metallic surfaces with emery, by lapping, honing, and other grinding operations are also considered. EF (8c)

The Finishing and Measurement of Gear Wheels. *Engineering,* Vol. 140, Aug. 16, 1935, pages 163-165. Describes and illustrates 4 machines made by the Michigan Tool Company of Detroit (a) for finishing rough-cut gears by application of a cutter-formed rack, (b) a lapping machine, (c) an involute-checking machine and (d) a helical-gear lead-checking machine. It is claimed that this gear-finishing machine will finish gears to closer limits on concentricity, contour and spacing than is possible by any other method and a contact surface of 85 to 95% can be obtained across the entire width of the gear tooth. For a more accurate finish the lapping machine combines the 3 motions in one machine of rotation, reciprocation and a relative sliding motion between the lap and the gear-wheel tooth faces. In the involute-checking machine the gear wheel is rotated round a fixed axis and not rolled while the contact point is given the necessary tangential displacement. The machine will accommodate gear wheels up to 12" in diameter by 12" width of face. The helical-gear lead-checking machine is designed on the principle that the lead is constant whether measured at the root diameter, pitch diameter or near the outside diameter of the gear, whereas when the angle of the spiral is being checked that angle changes in relation to the diameter. LFM (8c)

Tube and Sheet Grinding. *Mechanical World & Engineering Record,* Vol. 48, Oct. 11, 1935, pages 357, 364. The special grinding devices necessary for tubes and sheets due to their lack of rigidity are considered. The grinding machines described are of American design. WH (8c)

Machining Flat Surfaces by Disc Grinding. *Machinery,* London, Vol. 47, Oct. 31, 1935, pages 129-133. A new, deep-corrugated or plane face, coarse grit, grinding disc is used. The deep corrugated disc, like a circular waffle, always presents a sharp surface. They are mounted horizontally or vertically or duplex to grind opposite faces simultaneously. Production figures and costs are discussed, the various types of machines and wheels shown and products handled given in photos. Some of the discs are in one piece, others (the larger ones) are built up with removable sectors. VE (8c)

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Polishing in Drums (Das Polieren in Trommeln). F. SCHWARZ. *Oberflächentechnik,* Vol. 12, Oct. 15, 1935, pages 243-246. Polishing in drums is used in mass production of Cu-, brass-, Ni- or Cd-plated articles; Cr-plated articles cannot be polished in this manner. Rusty or scaled articles are first scoured in a wooden drum with sand wetted with water or dilute H_2SO_4. A polishing liquid for Al and Al alloys is acid KF 500 g., Na bisulphate 400 g., "Nekal" 100 g., water 100 l. For Fe and steel, soap flakes 4 kg., soda 2 kg., NaCN 0.5 kg., water 100 l. For Cu and Cu alloys: soap powder 3 kg., KOH 2 kg., NaCN 1 kg., water 100 l., or grain soap 4 kg., tartar 1 kg., Na bisulphate 1 kg., water 100 l. Polishing with balls is particularly used for strongly profiled parts, the balls being of very hard, highly polished Cr steel of 0.5 to 100 mm. diam. The procedure and the design of the drums are described in detail. 10 references. Ha (8c)

Polish Intensifies Sales Appeal of Hoover Products. FRED B. JACOBS. *Iron Age,* Vol. 136, Sept. 12, 1935, pages 20-23. By discussing the method of polishing household electrical appliances used by the Hoover Co., Canton, O., useful data on grits, wheel sizes, etc. are given. VSP (8c)

■ 8d. Electroplating ■

Chromium Plating Practice (Die Praxis der Verchromung). W. BIRETT. M. Krayn, Berlin, 1935. Paper, 6¾ x 9½ inches, 76 pages. Price 3.50 R.M. The author set as his goal the preparation of a concise simple description of chromium plating for the benefit of persons without a technical education who are engaged in this field. He has accomplished this without using any chemical or mathematical formulas, and without referring to original publications except in a few cases where illustrations were reprinted from them. The tabulation of defects and remedies will be of considerable value to electroplaters. No methods of chemical analysis are included but empirical tests for the content of sulphate and for throwing power are described.

The book is of interest to Americans who desire to compare the plating practice here and abroad. For the most part the German practice is very similar to the American. A few differences are of interest. For example, the customary American use of lead linings and lead heating coils in the plating tanks is not approved. The recommended thickness of Cr over Ni for appearance (p. 29) is 0.001 mm. (0.00004"), which is about twice that generally used in America.

The few references to theories are not always well founded. For example, the statement (p. 36) that Ni is used as an intermediate layer between the base metal and Cr because its coefficient of expansion is intermediate between those of the two metals, may be valid for plating on brass, but hardly on steel, as Ni has practically the same coefficient as steel.

One of the decided limitations of the booklet is its frequent reference to commercial firms for further details. For example, a description of "black chromium plating" occupies 4 pages, but makes no specific reference to the composition of the solution except that it is patented! W. Blum (8d) -B-

Electrolytic Deposits on Aluminum (Galvanische Ueberzüge auf Aluminium). G. ELSSNER. *Aluminium,* Vol. 17, July 1935, pages 376-378. Electroplating of Al consists in (1) cleaning in grease-solvents; (2) removal of all traces of grease; (3) preparation of the surface so that the deposit will adhere; (4) deposition proper; (5) subsequent treatment. The several steps are discussed fully. Only trichlorethylene, benzene or petroleum can be used for degreasing Al, and washing should be done in dilute HNO_3 with or without addition of HF, particularly for Cu-containing Al alloys. The surface should be roughened by pickling, preferably in dilute HCl or HF; sandblasting cannot be recommended. Alkaline pickling solutions are made up of sodium zincate with excess of alkali and used at 30°-40° C. The electroplating bath used depends to some extent on the surface treatment. Ni and acid Cu plating solutions are preferred. Al which was treated in a zincate solution can be Ni plated only in a citric Ni bath which must be stirred. Plating with Cd, brass or Cr requires an intermediary Ni layer. Cast objects are generally more or less porous so that electrolyte remains in the pores which may cause efflorescence. Subsequent treatment is recommended especially for them. Drying at 100° C. and closing of the pores by immersion in hot oil or fat is recommended. Ha (8d)

The Mechanism of Conductance. H. S. LUKENS. *Preprint* 67-23, *Electrochemical Society,* 1935, pages 317-324. Two electrodes (anode and cathode) were placed in an electrolyte contained in a shallow glass dish on the bottom of which was pasted a sheet of cross section paper. The path of current flow between the electrodes was investigated by means of two small movable electrodes connected to a galvanometer. From the positions of these exploratory electrodes relative to the cross-section paper, when the galvanometer showed no current flowing, the equipotential lines could be plotted. Several diagrams are given which show the equipotential lines for electrodes of different shapes in various arrangements within the cell. Results similar to those obtained with electrolytes were also obtained when a flat piece of sheet metal was used as the conducting medium. Suggestion is made that the mechanism of current flow, or flow of electrons, may be similar in electrolytes and in solid conductors. GBH (8d)

Chromium Plate on Aluminium. R. H. URE. *Sheet Metal Industries,* Vol. 9, July 1935, page 455. Vaguely outlines a process in which a quickly deposited brass coating having little adherence is covered with Ni and baked; after which it is polished and the Cr deposited. AWM (8d)

Adhesion and Causes of Nonadhesion of Electrodeposits (Das Haftvermögen und die Ursache des Nichthaftens galvanischer Ueberzüge). V. P. SACCHI. *Oberflächentechnik,* Vol. 12, Aug. 6, 1935, pages 185-196. See *Metals & Alloys,* Vol. 5, Dec. 1934, page MA 572. Ha (8d)

The Testing of Electrodeposited Coatings. L. C. BANNISTER. *Paper* presented before the *Electrodepositors' Technical Society,* Mar. 27, 1935, pages 97-108. The composition of deposits can be determined by chemical analysis, but the spectroscope offers best method for detecting impurities. Adherence of deposits can be qualitatively determined by noting flaking or peeling on specimens pulled to rupture in a tensile machine. GBH (8d)

Nickel Plating and Protection Against Corrosion (Les revêtements électrolytiques de nickel et la protection contre la corrosion). MARCEL BALLAY. *Métaux,* Vol. 9, Oct. 1934, pages 553-559. The thickness of electrodeposited Ni varies from 0.1 to several mm. according to type of service. Brinell hardness of this deposit is 200 to 400. GTM (8d)

Materials Aid Electrochemistry in Plating. JOHN C. BOGLE. *Machine Design,* Vol. 7, July 1935, pages 27-28. In discussing the large-scale electroplating of parts, it is shown that by anodically charging the entire framework of the barrel, the working parts of the barrel do not become plated. The anode potential of steel is several volts higher than that of the active anode material and all current is diverted through the latter. WH (8d)

Industrial Applications of Chromium Plating (Applications Industrielles du Chromage Électrolytique). JACQUES DU CHATENET. *Métaux et Machines (Science et Industrie),* Vol. 19, July 1935, pages 270-272. Describes applications for which pieces must have a high surface hardness together with a good corrosion resistance. FR (8d)

Zinc Plating. J. F. CALEF. *Monthly Review, American Electroplaters' Society,* Vol. 22, July 1935, pages 36-47. The paper is concerned primarily with cyanide Zn solutions for which several formulas are given. Reference is made to A.S.T.M. reports showing that Zn coatings on steel in many outdoor exposure tests gave better protection than Cd coatings. GBH (8d)

Joint Discharge of H^+ and Metal Ions from Solutions of Complex Cyanides (Gemeinsame Entladung der H^+- und Metallionen aus den Lösungen der komplexen Cyanide). O. ESSIN, A. BALABAJ & A. MATANZEW. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, June 1935, pages 216-222. Equation for the distribution of the current on different species of ions discharged simultaneously at an electrode, derived by ESSIN (*Zeitschrift für physikalische Chemie,* Abt. A, Vol. 171, 1935, pages 341-347) from the concepts of VOLMER's theory of overvoltage (*Zeitschrift für physikalische Chemie,* Abt. A, Vol. 150, 1930, pages 203-213) has been found to be valid for the joint discharge of H^+ and Zn^{++}, Cd^{++}, Cu^+, and Ag^+ ions from complex cyanide solutions by evaluation of the authors' own results and of those of GLASSTONE (*Journal Chemical Society,* London, 1929, pages 690-713 and 1930, pages 1237-1247) and SPITZER (*Zeitschrift für Elektrochemie,* Vol. 11, 1905, pages 345-368). From the results the γ-coefficients in Volmer's equation have been computed for the ions: Zn^{++}, Cd^{++}, Cu^+, and Ag^+. ORS (8d)

A Non-Poisonous Tin Bath (Ein ungiftiges Zinnbad). *Oberflächentechnik,* Vol. 12, Sept. 17, 1935, page 224. An alkaline Sn bath without cyanides to be used at 50°-60° C. is composed of Na stannate 7.5 kg., Na acetate 1.25 kg., NaOH 1.25 kg., starch 70 g., water 100 l. Anodes are partly of Sn, partly of Fe. The bath can be used for electrolytic tinning of kitchen utensils. It is added, however, that even if cyanide containing baths are employed there is no danger of poisoning foods by any poisonous components entrained in the deposit. Ha (8d)

Theory and Practice of Chromium Plating. II. (Theorie und Praxis der Verchromung. II). N. D. BIRÜKOFF, S. P. MAKARIEWA & A. A. TIMOCHIN. *Korrosion und Metallschutz,* Vol. 11, Sept. 1935, pages 193-201. The mechanism of Cr deposition was further investigated, the oxidation and reduction processes in Cr deposition having been discussed previously (*Korrosion und Metallschutz,* Vol. 11, Aug. 1935, pages 172-179). Three factors affect Cr deposition, namely, current density, temperature, and, to a certain extent, the concentration of the bath components, free H_2SO_4 or SO_4 anion, and active salts. If Cr is deposited from solutions of $H_2CrO_4 + H_2SO_4$ chromous oxide is formed on the cathode which gives on re-oxidation by the solution, $Cr_2\ (CrO_4)_2\ SO_4$ (chrom-chromate sulphate). The latter disintegrates slowly during interruption of the deposition process whereby H_2SO_4 is liberated which increases the current yield. The ratio of the velocities of Cr deposition and formation of Cr^{III} is very important; this ratio increases to a maximum in fresh solutions and in a time which depends on the H_2SO_4 concentration. The velocity of H deposition shows a periodicity depending on the condition of the cathode surface at the moment of the generation of the first crystallization centers of Cr and on the changes of the surface in the Cr deposition. Curves showing the influence of interruptions of the deposition process on current yield are given. 7 references. Ha (8d)

Method of Recovering Metals or Alloys by Displacement by Other Metals with More Marked Electropositive Character (Méthode de Recouvrement de Métaux ou Alliages par Déplacement d'autres Métaux à Caractere Électropositif plus Marqué). H. FORESTIER. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 592-594. The method is based on the displacement of a metal in one of its salts by another metal less electropositive, the solvents used being organic liquids. One may obtain by this method adherent deposits analogous to electrolytic deposits but not so thick. Ni, Co, Cu, Ag, Au and Zn were used. MAB (8d)

Electroplating with Rhodium and Rhenium (Das galvanische Überziehen mit Rhodium und Rhenium). H. ANDERSSEN. *Chemiker-Zeitung,* Vol. 59, May 8, 1935, pages 375-376 Rh plate is used on Ag to prevent tarnish. The best plating bath contains 4 g. Rh/l., 3% $(NH_4)_2SO_4$ and enough H_2SO_4 to bring the total SO_4 to 8 oz./l. It is used at 50° C. with current density up to 9 amps./dm.^{2} ½ min. is enough for plating Ag or brass. Polishing is not necessary. Rh is also used for reflectors and mirrors. The reflective power is not quite so good as freshly polished Ag, but it does not become dull like Ag. Re has good resistance to HCl. Several types of solution are used with 10-17 amps./dm.^{2} for 1-1½ min. They have good throwing power and polishing is unnecessary. CEM (8d)

The Metal Cleaning Handbook. ROBERT W. MITCHELL. Magnus Chemical Co., 96 South Ave., Garwood, N. J. Board, 6 x 9 inches, 208 pages. Price $1.00.

The book is intended to provide a ready reference and guide for the use of those directly interested in, or concerned with metal cleaning. The author is the technical director of the company. The chapters cover: equipment and methods; cleaning materials; metals cleaned; cleaning operations; and coolants and cutting lubricants. Advertisements are interspersed in the text, covering the various equipment and materials mentioned. In the letter of transmittal it is stated that a limited number are available if requested on a business letterhead. (8d) -B-

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The Specifications of Electrodeposits—Birmingham Conference of the Electrodepositors' Technical Society. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, June 7, 1935, pages 629-632. Abridged versions of two of the papers presented at the meeting: Specifications for Cathodic Coatings by C. F. J. Francis-Carter (see *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 454R/9) and Specifications for Anodic Deposits by S. Wernick (see *Metals & Alloys,* Vol. 6, Nov. 1935, page 454R/8). HBG (8d)

Some Further Principles of Electrochemistry Applied to Electrodeposition. No. VII—Complex Salts. SAMUEL FIELD. *Metal Industry,* London, Vol. 46, Apr. 5, 1935, pages 389-390. A survey of the salts commonly used in electrodeposition shows that many are complex in nature. Even when simple salts such as sulphates of Cu, Ni, Zn and Fe are used, it is frequently necessary to add, as in the case of Cu and Zn, the double cyanides. The relative rates at which simple ions migrate toward their respective electrodes, commonly designated as the transport or transference numbers, are listed for several electrolytes. From these a list of the common ions in the order of their relative speeds has been tabulated with H arbitrarily selected as standard on account of having the greatest speed. The absolute velocities for these ions have been determined either by actual measurement or by computation. In the discussion of the transference numbers of complex salts thus obtained are included CdI_2, NH_4I, the double cyanides, and the addition of Na_2SO_4 to Ni solutions for deposition on Zn-base die-castings. HBG (8d)

Making Molds for Plastic Materials by the Electroplating Process. H. CHASE. *Machinery,* N. Y., Vol. 41, June 1935, pages 590-591. Thick bronze shells made by depositing metal on a form or pattern are backed up with cast Al. Ha (8d)

The Determination of the Structure of Electrodeposits by Metallurgical Methods. D. J. MACNAUGHTAN & A. W. HOTHERSALL. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, Apr. 19, 1935, pages 439-441. Condensed from a paper presented to the Faraday Society on Mar. 30, 1935. The authors, using metallurgical methods, endeavored to determine the factors that influence structure of electrodeposited metals. Microscopic and X-ray examination were supplemented by physical tests and applications of these methods were used on the deposit after heat treatment. Nickel was the only metal studied thoroughly but the results indicate that other electrodeposited metals deserve study. Correlation of Brinell hardness with microstructure showed that, for the metal used, a definite relationship exists, hardness increasing with diminution in grain size. In discussing the properties of nickel deposits, the most significant result appeared to be the effect of solution pH in giving an abrupt increase in hardness at a certain critical value. A suggested cause of the hardness of nickel deposits is advanced. The effects of annealing and treatment in vacuo are discussed. Isolated applications of the methods that have been used on other electrodeposited metals are listed. The influence of low-temperature heat treatment, 200° C. and of the addition of colloids are also discussed. The hardness and microstructure of electrodeposited metals are listed in tabular form. HBG (8d)

The Microstructure of Electrodeposited Coatings. A. W. HOTHERSALL. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, Feb. 1, 1935, page 151. Abstract of a paper presented at a joint meeting of the Midland Metallurgical Societies and the Midland Centre of the Electrodepositors' Technical Society, Jan. 3, 1935. The author described the microstructure of some electrodeposited metals and pointed out that, in general, the surface appearance of such metals give a clear indication of the microstructure. Coarse crystalline deposits have a matte appearance which gradually grades to a mirror-bright appearance for very fine crystals. A notable exception is Cr for which the matte or bright appearance can be obtained at will for very fine crystals. Deposits described were crystalline and were classified; (1) symmetrical groups—acicular crystals, columnar or fibrous crystals, (2) conical compact deposits—twinned structures, and (3) broken structures—arboreal and powdery structures. Data on the Brinell hardness of different deposits of a number of metals are given. It is stated that there is a definite relation between Brinell hardness and microstructure. A fine grain structure is accompanied by high tensile strength and low elongation while a coarse structure has low tensile strength and high elongation. Some of the theories advanced to account for the wide range in physical properties and the variation in the microstructure obtained are reviewed. Discussion of the paper is included. HBG (8d)

Cadmium Plating. H. MARSTON. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 45, Oct. 19, 1934, pages 374-376; Nov. 2, 1934, pages 425-426. Paper presented at a meeting of the Electrodepositors' Technical Society, Birmingham Centre Sept. 25 under the chairmanship of Maurice Cook. Cd was discovered by Stromeyer in 1817. Silesia in Germany and the U. S. A. are the sources of the major portion of the world's output. It was used chiefly in dyes and pigments until the latter stages of the World War when the scarcity of Sn caused it to be used as a Sn-substitute. The first patent for the electrodeposition of Cd was granted to Russell & Woolrich in 1849. It was not until 1920 that experiments were conducted in the U. S. A. with Cd plating for rustproofing and not until 1924 in England. The satisfactory solution now used differs but little from that of the first patent. Prior to 1920 only Zn was considered for rustproofing but the use of Cd has increased since due to certain advantages of Cd over Zn: (1) Cd is denser than Zn and (2) an equal thickness of Cd can be electrodeposited at a more rapid rate. The author lists 4 reasons for the increasing popularity of Cd-plating, viz: (1) efficiency in rustproof properties, (2) ease of application in processing, (3) the small amount of metal required to be deposited in order to obtain good rustproof and (4) the attractive color and resistance to oxidation when buffed. One disadvantage of Cd is that it is useless against steam erosion. The author recommends a cyanide solution for general work and gives 2 formulae. Deposition at room temperature with a current density of 12 amp./ft.^{2} at 6 volts is recommended. Methods of analysis for metallic Cd, free cyanide and NaOH in the plating solution are given. Precautions to be taken and remedies for some plating troubles are listed. Careful electrical control is emphasized. Semi-circular cast anodes are used in the barrel-plating equipment described. The treatment both before and after plating of ferrous and non-ferrous materials is discussed. It is predicted the future of Cd plating lies in the protection against corrosion of articles that are handled but little after plating. HBG (8d)

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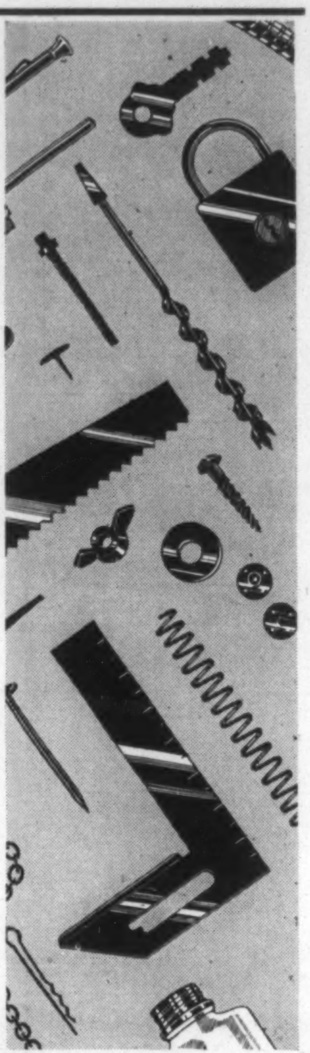

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8e. Metallic Coatings other than Electroplating

Handbook of Metal Spraying (Handbuch der Metallspritz-Technik). M. U. Schoop & C. H. Daeschle. Rascher & Cie. A. G. Verlag, Zürich, 1935. Paper, 7 x 10¼ inches, 168 pages. Price 8 RM. Of the eight chapters which constitute this book, the metallurgist's interest will be confined largely to two, Nos. 5 and 6. In the first 3 chapters is considered the development in detail, from simple basic principles, of the various devices for spraying metals and the discussion is replete with mechanical details. Chap. 1 is devoted to the methods utilizing molten metal and powdered metals, respectively. Chap. 2 considers the spraying process in which the basic material is in wire form which is melted by gas flame, whereas Chap. 3 deals with the process in which the wire is melted by an electric arc. Chap. 4 is a discussion that should appeal particularly to the practical man or prospective user of the process; air compressors, sand blasting equipment, ventilators, acetylene generators, etc. are discussed.

Chap. 5 dealing with the fundamental aspects of the metal-spraying process and the characteristic properties of the redeposited metals and Chap. 6 dealing with practical applications of the method should prove of value to metallurgists in general. Some of the applications, however, such as the metal-spraying of the tips of wooden airplane propellers are somewhat out of date according to American practice, whereas other uses such as those for the preparation of electrically conducting bandages for therapeutic treatment are somewhat novel. The paucity of data to show the trustworthiness of sprayed-metal coatings under actual service conditions particularly as a protection against all-weather corrosion is disappointing.

The discussion, Chap. 7, of the finishing of sprayed-metal coatings by polishing and coloring is very scanty, and Chap. 8 which, prefaced by the motto "From experiment to 20% dividend is a long way," is devoted to the difficulties encountered in the patent situation during the years of development of the process would appear to have no place whatsoever in an impartial technical discussion.

A growing interest in the commercial applications of the metal-spraying process has been shown in this country in the past few years and a book such as this one should prove a very convenient source of reference. Its value would, of course, be increased many fold if it were available in English. H. S. Rawdon (8e) -B-

Aluminum Coating (Aluminiumplattierung). H. G. Heine. *Aluminium*, Vol. 17, Sept. 1935, pages 467-476. The development of and the underlying principles for coating Al and Al alloys with other metals to make them more resistant both mechanically and against corrosion are reviewed. The principal development began in 1926 when Al alloys or impure Al were coated by rolling-on and simultaneously welding a surface layer of pure Al. To obtain harder surfaces, Al alloy of Mn or Be was used as coating, also alloys with Cr, Mg or Ti. The degree of diffusion between the core material and the coating is of great importance with regard to corrosion especially if the core is of Cu or Cu alloys, and depends largely on the temperatures used in coating. The mechanical properties of coated alloys depend mainly on the properties of the core material, but the surface hardness depends on the covering material. Coated materials cannot very well be joined by welding as the strength is seriously impaired; riveting is recommended. To reduce corrosion resulting from local elements formed by contact of metals of different potential, the use of rivets with coated shafts is recommended so that only similar materials come into contact. A great number of examples of use of coated parts are described. Patent literature and 38 references are cited. Ha (8e)

Special Cementation of Metallurgical Products as Protection against Corrosion (Protection des produits métallurgiques contre la corrosion par cémentations speciales). J. Laissus. *Métaux*, Vol. 9, Oct. 1934, pages 537-549. 10 references. In weathering corrosion tests an index of corrosion can be obtained by the formula $P = \frac{P'-P''}{S}$, where P′ is the initial weight of sample in mg., P″ is the weight of sample after corrosion test, and S is the total surface. Salt spray tests are made by exposing samples within an enclosed space to a mist of synthetic sea-water of the following composition: 27 g. NaCl, 0.5 g. KCl, 3.5 g. $MgCl_2$, 2.5 g. $MgSO_4$, 0.5 g. $CaSO_4$, 966 g. distilled water. Special forms of cementation are used as proteetion against corrosion. Cementation is usually done at temperatures below 500° C. Sherardization, or cementation by Zn, at 350° C. is a successful treatment against rusting of ferrous material. Cementation by Cd is even better than that of Zn. Special cementations at temperatures 500° to 1000° C. are by Al, or calorizing process, and by nitriding. Special cementations operating at temperatures higher than 1000° C. are those with Cr, W, Mo, Ta, V, Co, B, U, Zr and Ti. GTM (8e)

Spraying Liquid Metal to Decrease Corrosion. R. E. Kunkler. *World Petroleum*, Vol. 6, Sept. 1935, pages 525-528. One of the most efficient means of overcoming the H_2S corrosion so prevalent in the equipment for oil cracking processes was found to consist in spraying pure Al on all exposed surfaces. An oxy-acetylene torch was used for spraying, the thickness of the coating being 0.015-0.020″. Ha (8e)

Cementation by Means of Silicon Powder. Tsutomu Kase. *Kinzoku no Kenkyu*, Vol. 12, Aug. 1935, pages 397-438. In Japanese. By means of pulverized commercial Si the cementation of Fe, Ni, and Cu with Si at various temperatures between 500°-1200° C. was investigated. The depth of penetration of cementation was measured, microscopically and by chemical analysis, and the resistance to oxidation at high temperatures and to corrosion by some acids were studied. The following facts were found: Si diffuses into the metals mentioned at a temperature over 500°, and the rate of diffusion increases with increase of temperature. An abrupt increase in the rate of diffusion of Si into Fe occurs at the A_3 point (906°). The relation between the weight increase of the specimen (ΔW), or the depth of penetration (P), and the absolute temperature of cementation (T) can be expressed as an exponential function, ΔW (or P) $= ae^{-b/T}$, as in the other case previously studied by the writer. Also the relation between the ΔW or P and the length of cementation period (Θ) can be given by a similar function. Though the Si-cemented surfaces of Fe and Ni are brittle, they resist oxidation at high temperatures. Likewise they are not easily attacked by dilute H_2SO_4. The surfaces of Cu cemented by Si are porous, and the weight of the specimens decreases on cementation. KT (8e)

8f. Non-Metallic Coatings

Enamels. Andrew I. Andrews. Twin City Printing Company, Champaign, Illinois, 1935. Cloth, 6 x 9¼ inches, 410 pages. Price $5.50.

This volume which deals with the preparation, application and properties of vitreous enamels, is written by a professor of ceramic engineering at the University of Illinois, and its publication approved by the Fellows of the American Ceramic Society and the Porcelain Enamel Institute. Enameling has only recently started to develop from an art into a science. Its technology is likewise emerging from a small-scale batch basis into a continuous, quantity-production basis. The book recognizes both the scientific and the practical angles of the problems involved, for example, showing the various equilibrium diagrams of the silicate systems of the various components of enamel, but recognizing that a practical enamel is much too complex to be completely explained by any three-dimensional diagram. The raw materials are described, calculation of batches explained, and compositions of various types of enamels given. Making the frit, milling it, the application of wet and dry enamels, furnaces and firing practice are all discussed. A wide variety of tests, generally of a rather simple nature, by which some of the fundamental properties of enamels may be more or less satisfactorily evaluated are described, most of which have some analogy in metallurgical testing. The discussion of what goes on at each stage of the enameling process, and why things are done as they are, is quite clear, and a reader with no initial knowledge of the enameling industry would get a pretty sound idea of it from the book. It will be helpful to the metallurgist interested in enameling stock in telling what the enamelist is going to do to the metal. The sections dealing with steel and cast iron for enameling are less satisfactory and consist of generalities that are not very helpful. Reference is made to various defects due to the metal without much real information as to the metallurgical causes. Heat-resisting alloys for use in enameling furnaces are mentioned, but the discussion is not very informative. Cleaning and pickling of steel and sand blasting of cast iron preparatory to enameling are interestingly discussed. Methods of arranging for the weighing out of enamel batches by the workmen on "blind" scales or by other methods so that they can't give the composition of the batch away to a competitor are discussed. One wonders if the expert enamelist hasn't a pretty clear idea of the properties of different batches so that by applying some of the standard tests and getting a little chemical help, followed by a little experimentation, he could duplicate the product. Despite the vagueness of the metallurgical sections, the book, as a whole, is a very good job. No such clear and up-to-date descriptions of the how and why of enameling is available elsewhere in connected form. H. W. Gillett (8f)—B—

The **Surface Refining of Metals. Vol. I. Metal Coloring (Oberflächenveredlung der Metalle. I. Die Metallfärbung).** Georg Buchner. M. Krayn, Berlin, 1935. Paper 5¾ x 8 inches, 149 pages. Price 8.50 RM. The present edition of this book, the fourth, represents a very considerable increase in size over the last one, 1922, which covered both etching and coloring of metals. In the present edition, two volumes are promised, the one covered in this review being volume I which deals with the coloring of metals. The etching of metals will form the subject matter of volume II.

Considerable new material relating to the more general and fundamental aspects of the coloring of metal surfaces has been added. The first part of the book deals with this under the headings; chemical coloring methods, natural and artificial, with and without electrolytic methods, mechanical methods of coloring and combination methods. Chemical methods, naturally, constitute the greater part of the discussion. The table of contents, which is detailed enough almost to constitute an index in itself, is somewhat disappointing since the author has not made the items in the contents agree in wording with the section headings and the occasional errors in page notation add to this.

The greater part of the book, of course, deals with the discussion of the various methods for coloring different metals. Preceding this, however, is a section summarizing cleaning methods. Chemical methods are given for producing all the various imaginable color effects on the various metals, the instructions, though concise, give all the essential information required for carrying out the method. The book should appeal particularly to the practical worker in finishing of metals. There may be some criticism, however, by such users in that the author has not attempted to express the relative advantages or disadvantages of methods intended for the same general purpose. For example, for producing a brown finish on copper-plated surfaces five methods which are distinctly different in character are described. However, the reader is given no intimation, other than the order of presentation, of the relative importance which the author may attach to any of these.

H. S. Rawdon (8f) -B-

The **Use of a Nickel Dip in Enameling Practice.** J. E. Hansen & J. T. Irwin. *Journal American Ceramic Society,* Vol. 18, Aug. 1935, pages 225-229; *Enamelist,* Vol. 12, Sept. 1935, pages 11-15, 51-52. After degreasing and pickling to remove oil and scale, the metal is dipped in Ni or Co bath to promote adherence and to minimize defects such as copperheads, etc. Single or double Ni salts are used for the bath but better results are obtained with the single salt. The pH is held between 5.6 and 6.2 with a buffer of boric acid with or without $(NH_4)_2CO_3$ and/or NH_4OH. Operating conditions are given in a table. Typical results obtained with the Ni dip are shown in photos and described in the test. Ha + WB (8f)

The Adherence of Glass to Metals. Nelson W. Taylor. *Glass Industry,* Vol. 16, Aug. 1935, pages 243-246. Requirements of good seal are good contact or bond by means of chemical reaction and a strain-free condition of the finished seal. The question of an exact match of coefficient of expansion of metal and glass or, as some recommend, a slightly higher coefficient for the metal in order to keep the glass in compression is reviewed. The criterion is seen to be the quality of the chemical bond. The accompanying problem of non-adherence is important with respect to machine handling of molten glass, etc. For this purpose clean, non-oxidizing metal surfaces are required whereas a good metal seal may require an oxide on the metal surface before or during the application of the glass. Thermodynamics of the problem are reviewed. Adherence studies indicate need for transition zone and the use of oxide film on the metal to dissolve in the applied glass. Various methods of oxidizing the metal surface are reviewed. WB (8f)

Temperature-Indicating Colors in Aluminum Switching Installations (Temperaturanmeldefarben in Aluminium-Schaltanlagen). C. Geier, W. v. Zwehl & W. Helling. *Aluminium,* Vol. 17, July 1935, pages 375-376. To detect whether or not Al parts and joints have reached too high a temperature they are coated with certain temperature-sensitive paints which are reversible in the admissible temperature range but irreversible if heated above the range in which case they retain the changed color. Iodine salts are preferably used for this purpose. A number of color schemes are described and the behavior of Al painted with such color under the action of several chemicals was determined. The paints do not corrode Al, but should be renewed every 2-3 years as they lose their sensitivity. Ha (8f)

Note on Relation between Cobalt and Nickel Oxide Content and Reboiling of Sheet Steel Ground Coats. J. M. Cayford & R. M. King. *Journal American Ceramic Society,* Vol. 18, July 1935, page 224. Tests to determine duration and persistence of reboiling on enamels containing varying amounts of Co and Ni oxides showed max. for Co alone at .4-.5% with a decrease practically to zero at 2%; max. duration and persistence for Ni alone at 1.5% with a decrease in duration at 2% but none in persistence; when both are present lower values of both are obtained, likewise when Mn oxide was used with Co and Ni oxides. Results are summarized in curves. WB (8f)

The Anodic Coating of Aluminum. H. K. Work. *Monthly Review, American Electroplaters' Society,* Vol. 22, Apr. 1935, pages 32-39. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 405R/6. GBH (8f)

A High-Solid Synthetic Surfacer for Metal. K. N. Kathju. *Industrial Finishing,* Vol. 10, Sept. 1934, pages 16-18. A new high-solid lacquer for spraying automobiles and metal surfaces is specified as follows: solids, 63%; sp. g., 48-50 H. L. at 60° F.; viscosity, 23-28 sec. Properties and advantages are listed. JN (8f)

Trend Toward One Cover Coat Enamel. Frank R. Porter. *Steel,* Vol. 97, July 22, 1935, page 34. See "The Production of One Cover Coat Enamel Finishes on Sheet Steel," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 406R/8. MS (8f)

Chemical Deposits (Depôts Chimiques). Charles Boulanger. *Métaux,* Vol. 9, Oct. 1934, pages 501-502. Attempts were made to produce chemical deposits on Al and its alloys by using solutions of 1% Na_3PO_4, $NaNO_3$, $Na_2B_4O_7$, $Cu(NO_3)_2$, Na_2SO_3, Na_2CO_3, $(NH_4)CO_3$, all solutions being used at various temperatures (15°-50° C. and 100° C.). No protective coatings were formed by any of the salts used except when an oxide film was formed as a result. Metallic deposits in some cases were successful. GTM (8f)

Copperheads or Iron Oxide Defects in Porcelain Enamel. J. J. Canfield. *Iron Age,* Vol. 136, Aug. 15, 1935, pages 30-34. Factors causing Fe_2O_3 defects in enamels are discussed together with various practices for minimizing or eliminating them. Copperheads can be largely eliminated by proper cleaning practice. Other causes are: thin enamel coat, metal surface, improper drying, etc. VSP (8f)

Anodic Oxidation of Al and Its Alloys (L'oxydation anodique de l'aluminium et de ses alliages). A. Dumas. *Métaux,* Vol. 9, Oct. 1934, pages 550-552. Anodic oxidation processes are grouped according to the acid used as electrolyte: chromic, sulphuric or oxalic. The thickness of oxide layer varies linearly with the amount of electricity used. This thickness varies from 5μ to 50μ. Elasticity of the film depends upon bath temperature, concentration, length of treatment, voltage and the nature of the current. Film formed at low temperature and low voltage is very resistant. In practice the amount of current used varies according to the process: for chromic acid 2-4 kw. hr./m.^{2}; 0.7 to 2 kw. hr. for H_2SO_4 and 10-20 kw. hr. for oxalic acid. This film will take any color, if the sample is immersed in organic color solution. Al and its alloys used in hydroplanes are all anodically oxidized. GTM (8f)

Painting Aluminum and Its Alloys. Junius D. Edwards & Robert I. Wray. *Industrial & Engineering Chemistry,* Vol. 27, Oct. 1935, pages 1145-1149. Minor differences in paint adhesion have been noted on different wrought alloys of Al, and some observations on the correlation of paint adhesion and alloy composition are presented. The passivating of surfaces, as best exemplified by anodic coatings, minimizes any differences between alloys and gives an excellent base for holding paint, particularly where subjected to immersion in water or very humid conditions. Even without special surface preparation, Al alloys hold paint very satisfactorily in comparison with other structural metals. Before painting or repainting of surfaces which have been corroded, preliminary treatment with chromate solution has been found effective. MEH (8f)

A Study of Furnace Atmospheres and Temperature Gradients and Their Effect on Porcelain Enameling. H. E. Ebright, G. H. McIntyre & J. T. Irwin. *Enamelist,* Vol. 13, Oct. 1935, pages 5-8, 35-43. Furnace conditions, especially in continuous furnaces, were investigated; the reasons for defects in the enamel discussed and means for avoiding them suggested. 11 references. Ha (8f)

Reconditioning Electric Cookers. P. W. Bignell. *Electrical Review,* Vol. 117, Aug. 23, 1935, pages 235-237. On the basis of experience of Eastbourne Electricity Dept. in renovating old-fashioned cookers with stove black enamel finish to look like modern vitreous enameled models it was shown that a heat-resisting synthetic resin stoving enamel gave better results than the cellulose coating tried. The finish of stoving enamel, approached vitreous enamel in appearance; twice as many cookers were sprayed per gal. as compared with cellulose (only 2 coats being necessary instead of 3 of cellulose); amyl acetate fumes were eliminated and painting costs were reduced. Total cost of reconditioning with stove enamel was 20% less than with the cellulose coating. MS (8f)

Attractive Finish Helps Metal Products Sales. Edgar W. Funk. *Iron Age,* Vol. 136, Aug. 29, 1935, pages 22-24. A recently developed high-baking synthetic enamel, baked at 275° to 300° F., will produce a pure white finish. It has good adhesion to metal, so that it constitutes a satisfactory, one-coat finish, or can be used over primer for higher grade 2 or 3-coat work. VSP (8f)

9. TESTING

A Survey of Testing in the Precious Alloy Field, with Some Notes on the Testing Requirements for Duplex Alloys. THOMAS A. WRIGHT. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 341-369. Includes discussion. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 501L/2. (9)

9a. Inspection & Defects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

Flash Magnetisation for Examining Castings and Forgings. A. G. WARREN. *Engineering,* Vol. 140, Oct. 4, 1935, pages 353-354. The Radiological Branch of the Research Department, Woolwich, has developed a simplified method of examining forgings and castings. The usual method requires a stationary magnet which in use on large specimens is unsatisfactory. In this method a magnetizing coil is passed through a steel cylinder and when the current is applied the cylinder forms a closed magnetic circuit. After the current is shut off 90% of the magnetism is retained. The specimen is then sprayed with finely-divided Fe particles and minute surface cracks invisible except under rather high magnification become plainly visible. Only the outside and inside surfaces need be magnetized so eddy currents are not a disadvantage as they permit rapid magnetization of the surface layers. The current is maintained long enough to blow a fine fuse, the size of which is varied to suit the requirements. The construction of the magnetizing coil is described and illustrated. LFM (9a)

Mechanical and Non-destructive Testing of Pressure Vessels and Welds with Particular Reference to Sub-zero Operation. R. K. HOPKINS. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 243-258. A.S.M.E. requirements for Class 1 welded pressure vessels are given. Properties of a 0.24 C-2.5% Ni steel are given. At —75° F. this steel has a high impact resistance if properly treated. Sub-zero tests on tanks made from this steel by welding are described. See also *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 501L/5. JLG (9a)

Rapid Determination of Nickel in 18 and 8 and other High Chromium Steels and Alloys. FRED P. PETERS. *Metals & Alloys,* Vol. 6, Oct. 1935, pages 276-279. 11 references. Describes method of cyanide titration of Ni in the presence of large amounts of Cr. Oxidation of Cr to hexavalent state removes the interference due to color of the trivalent ion of Cr. WLC (9a)

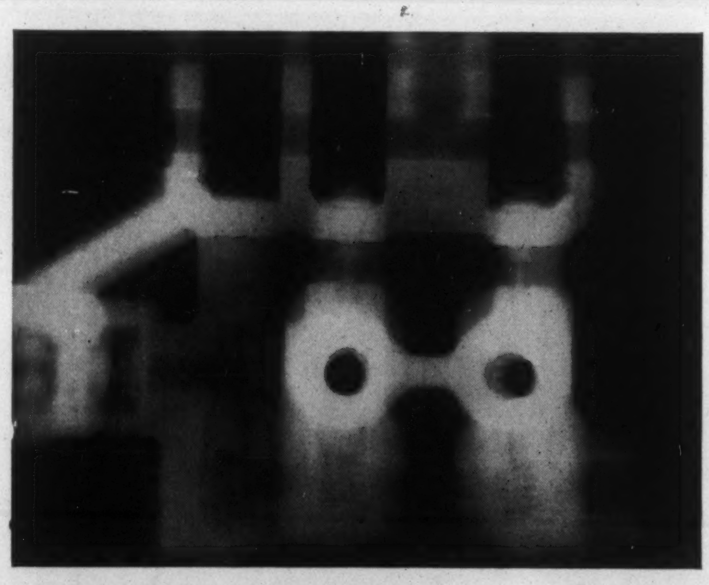
X-rays in Metallurgy (Los Rayos X en la Metallurgia). F. MORRAL. *Metalurgia y Construccion Mecanica,* Vol. 1, Nov. 1935, pages 21-23. Principles and practice of using X-rays for metallurgical problems, e.g. detection of faults in solid metal and determination of structure are briefly described. Ha (9a)

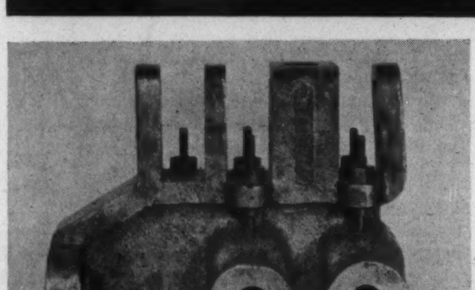
X-ray Investigation of Stress Distribution and Excess Stresses in Ingot Steel (Röntgenographische Untersuchung über Spannungsverteilung und Ueberspannungen in Flussstahl). H. MÖLLER & J. BARBERS. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung Düsseldorf,* Vol. 17, No. 12, 1935, pages 157-166. The X-ray back reflection method was found particularly suitable to study the question whether the occurrence of excessive interior stresses is necessarily connected with the existence of non-uniform stress distribution and if a relation between those 2 quantities exists. The equipment and theory of the tests (bending and tension) are described in detail. The results show that a simple linear relation between load and stress exists only under comparatively small loads. Under higher loads, the stress distribution becomes very irregular even below the flow limit. There occur differences in tension between adjoining groups of crystallites, even under theoretically uniform load, which are equal to those produced intentionally in the bending test. Equations are derived for the effect of elastic anisotropy on X-ray measurements of the ratio of Young's modulus to Poisson's ratio. 9 references. Ha (9a)

Hydrogen as the Cause of Flakes in Steel. HANS DIERGARTEN. *Metal Progress,* Vol. 28, Sept. 1935, pages 63-64. Pressure caused by H_2 is stated to be essential cause of flakes, with segregation, inclusion and mechanical stresses often critical factors in determining the sufficiency of H_2 to cause flake formation. WLC (9a)

Internal Fissures in Railroad Rails. H. F. MOORE. *Metal Progress,* Vol. 28, Nov. 1935, pages 46-52. Reports tests made in laboratory simulating the service conditions. Results show that failure occurs from the surface in sound rails and that internal cracks probably formed in cooling the rails on the mill hot bed are the only source of internal failures. WLC (9a)

A New Photoelastic Material. A. G. SOLAKIAN. *Mechanical Engineering,* Vol. 57, Dec. 1935, pages 767-771. Marblette is a transparent phenolitic material which has proved to possess greater advantages in photoelastic testing than bakelite or other materials used for this purpose because of its high stress-optical coefficient, the ease with which it can be machined and cast into intricate shapes, and its freedom from initial stresses. Comparative figures of physical properties with other materials are given and fringe patterns reproduced which show the greater clearness of the photoelastic pattern. 19 references. Ha (9a)





Unretouched photo of intricate bronze casting and, above, radiograph of same casting.

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9b. Physical & Mechanical Testing

W. A. TUCKER, SECTION EDITOR

A. S. T. M. Investigates Hardness Testing and Creep of Aluminum Alloys. *Iron Age*, Vol. 135, June 27, 1935, pages 21-27, 66. Abstract of papers read before the American Society for Testing Materials at Detroit on correct method of determining hardness method and creep characteristics at various temperatures of Al alloys. Includes several tables. VSP (9b)

Relationship in Cast-Iron Test Results. G. L. HARBACH. *Foundry Trade Journal*, Vol. 53, July 25, 1935, pages 61-63, 72; Aug. 1, 1935, pages 85-87. A paper read before the Annual Meeting of the Institute of British Foundrymen, July 1935. Effect of incorrect size on transverse breaking load, relation between transverse and tensile strengths, effect of surface condition on the transverse results, effect of span on modulus of rupture, etc. are discussed. All the bars dealt with were cast on end in green sand except the high-test irons which were mainly cast in dry sand. They were made by drawing the pattern out full length, thus avoiding the interference of a joint and providing bars practically true to shape. It was shown by a number of diagrams that the ratio obtained by dividing the transverse (modulus of rupture) by the tensile strength decreases as the strength increases. In other words, tensile strength increases proportionally more rapidly than transverse strength. On the whole, the author states, it is felt that for irons in which strength is an important feature the transverse test is a useful guide for routine tests, but for all other purposes the determination of tensile strength is preferable to estimation from transverse strength. It is well known that the breaking load of a test-piece is affected by the surface finish, but against this, so far as cast iron is concerned, it is popularly believed that the skin is the strongest part of a bar, although usually in such a case the surface is bound to be rough. According to the author machining of high-strength bars is to be recommended if the real strength is to be determined. Machined transverse bars are higher in strength than bars tested "as cast." The results obtained by the author seem to confirm generally accepted opinion that modulus of rupture increases with decreasing span. Fracture according to the author is not always a reliable guide to strength, as the center of a thick section may show coarse grain without necessarily being weak and thin sections of weak irons, although close grained, are not strong. AIK (9b)

Hardness Testing. R. A. HALLOWAY. *Heat Treating & Forging*, Vol. 21, Aug. 1935, pages 377-381; Sept. 1935, pages 435-438, 451. Paper read before the Steel Treatment Society, Australia. Describes various types and makes of instruments for testing hardness, and discusses some of the underlying theory, requirements of a satisfactory tester, and future developments. MS (9b)

Destructive Tests on Welded and Plain Structural Steel Specimens (Versuche über Brüche in ungeschweissten und geschweissten Probestücken aus Baustahl). E. G. COKER & B. P. HAIGH. *Schiffbau, Schiffahrt & Hafenbau*, Vol. 36, July 15, 1935, pages 227-228. Graphical presentation of testing results reported at the Spring meeting of the Institution of Naval Architects. See "An Experimental Investigation of Cracking in Mild Steel Plates and Welded Seams," *Metals & Alloys*, Vol. 6, July 1935, page MA 291L/4. WH (9b)

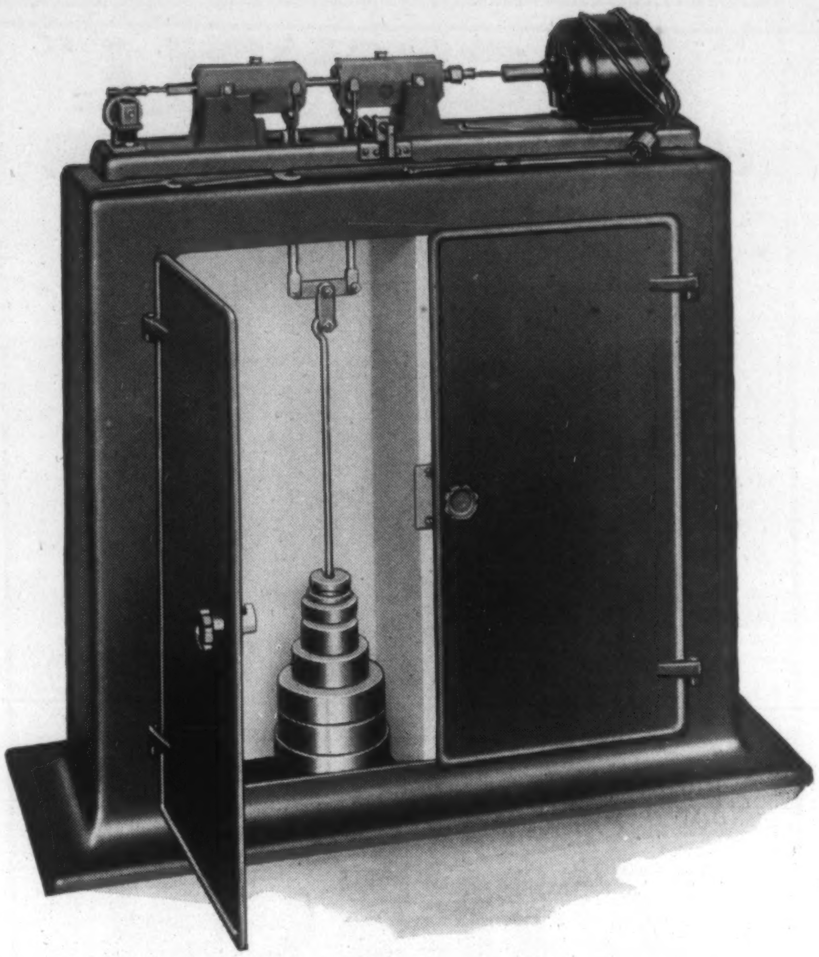
Testing Engineering Materials. IV. Torsion Tests. J. TRICKETT. *Mechanical World & Engineering Record*, Vol. 48, July 12, 1935, pages 29-30. Torsion tests may be required for determining the modulus of rigidity of a specimen or for testing finishing products. Typical methods and machines are described. WH (9b)

Tests of Steel Tower Columns for the George Washington Bridge. AMBROSE H. STANG & HERBERT L. WHITTEMORE. *Bureau of Standards Journal of Research*, Vol. 15, Sept. 1935, pages 317-339. The columns were made of C steel, Si steel, and C-Mn steel and were tested in the hydraulic compression machine at the Bureau of Standards. The shortening of the columns was measured, using compressometers and electric telemeters, and the lateral deflection was measured at midheight. The tensile properties of the material were determined from coupons. Results are given. WAT (9b)

Report of Creep Tests for Gas Welded (Low Carbon) Steel. N. F. WARD. *Welding Journal*, N. Y., Vol. 14, Oct. 1935, pages 13-19. Tests on cold rolled, gas welded and annealed, .09 C mild steel are reported. Short time tensile test results are given for temperatures up to about 1500° F. and stepped, long-time tests for temperatures from 350° to 998° F. with stress from 5600-12700 lbs./in.^{2} WB (9b)

Fluid Pressure Cupping Test for Materials Used in Cold Pressing. H. J. GOUGH & G. A. HANKINS. *Sheet Metal Industries*, Vol. 9, Apr. 1935, pages 191-195. Discussion included. A summarization of work done at the N.P.L. in investigating the usefulness of the fluid cupping test as a means of evaluating the suitability of sheets for deep drawing. It is pointed out that the cupping coefficient ($\frac{h^2}{r^2}$ where h = height of cup at fracture and r = radius of jaws) alone is not a satisfactory measure of the merit of a sheet. When stress-deformation curves were coupled with the cupping coefficient it was seen that the discrimination possibilities of the test were probably very great. AWM (9b)

Photographic Micromachine for Mechanical Test of Metals (Micromachines a enregistrement photographique pour l'essai mecanique des métaux). PIERRE CHEVENARD. *Métaux*, Vol. 10, Feb. 1935, pages 37-49. The micro-mechanical study of welds, carried out on micro-testpieces, taken from the welded zone, is extremely useful in determining the welding qualities of a metal or the effects of a method of welding. The micro-machine was perfected in the Laboratory of Acieres d'Imphy. This new apparatus is used only for tensile, shearing and deflection tests on specimens 1 to 1.5 mm. in diameter. The stress-strain movements are registered photographically, and the elastic limit, ultimate and elongation can be traced accurately. The micro-testpieces for tension with screwed heads are 1.5 mm. in diam., 15 mm. long overall with an effective length of 7 mm. The testpiece is held in 2 cylindro-spherical jaws, movement being prevented by a clamp. For shearing test a bar 1.5 mm. in diameter and several cm. long is used. See also *Metals & Alloys*, Vol. 6, Nov. 1935, page MA 456L/9. GTM (9b)



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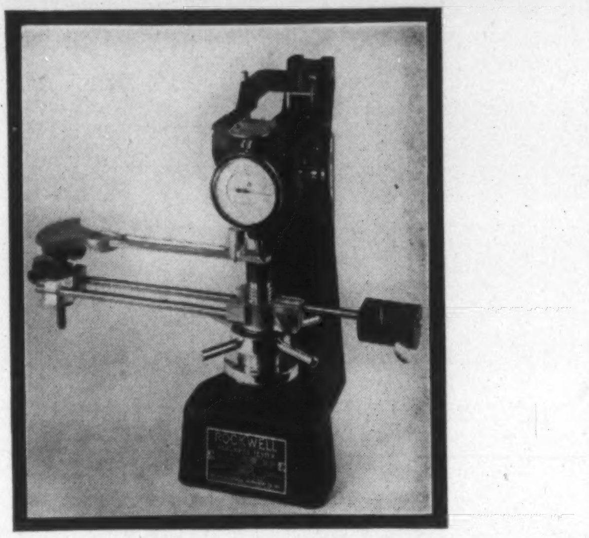

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Energy Bands in Copper. Harry M. Krutter. *Physical Review,* Vol. 48, Oct. 1935, pages 664-671. The general method of obtaining energy bands and wave functions for a face-centered lattice has been outlined. The method has been applied to a Cu lattice using a corrected Hartree potential field. The energy bands as a function of the internuclear distance have been calculated. The strong overlapping of the 3d band and the 4s band is shown. The assignment of electrons to the lowest energy bands leads to a satisfactory explanation of the well-known fact that Cu is a good conductor. The various energy bands of the three directions 100, 110, and 111 have been correlated. WAT (9b)

An Extensometer Comparator. Ambrose H. Stang & Leroy R. Sweetman. *Bureau of Standards Journal of Research,* Vol. 15, Sept. 1935, pages 199-203. An extensometer comparator for the calibration of extensometers, compressometers, micrometer dials, and strain gages is described. The comparator has given satisfactory results in calibrating length-measuring instruments used for material testing. WAT (9b)

9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Endurance Properties of Light Metals Especially Duralumin (Über die Dauerfestigkeit von Leichtmetallen mit besonderer Berücksichtigung von Duralumin). J. Krystof. *Metallwirtschaft,* Vol. 14, Aug. 30, 1935, pages 701-702. Some recent investigations of corrosion fatigue of Al and Mg alloys and the effect of protective coatings are reviewed. Preliminary stressing greatly increases the endurance limit of duralumin. 6 references. CEM (9c)

Effect of Surface Rolling on the Fatigue Strength of Steel. O. J. Horger. *Journal of Applied Mechanics, A.S.M.E.,* Vol. 2, Dec. 1935, pages A128-A136. The effect of cold-working on the endurance limit and other related physical properties of steel is discussed. The conclusions are that fatigue strength may be increased from 24 to 32%, roller shape has little effect on the increased fatigue strength, that the minimum roller feed for about max. fatigue strength may be expressed by a ratio of roller contact width to roller feed equal to 2 or greater. The irregularity of the surface finish obtained by rolling may be controlled by proper feed. Mild heat-treatment after rolling gives 6% additional fatigue strength. Cold-stretching of fatigue specimens in tension increased fatigue strength as much as 35%. Surface rolling of previously cold-worked steel does not give as great an increase in fatigue strength as the annealed steel. 33 references. Ha (9c)

Rear Axle Gears: Factors which Influence their Life. J. O. Almen & A. L. Boegehold. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 99-146. Includes discussion. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 331L/1. (9c)

Fatigue Strength of Cold Rolled Steel for Aircraft (Utmattningshållfasthet hos kallvalsat stål för flygplan) Otto Forsman. *Ingeniörs Vetenskaps Akademiens Handlingar,* 1934, No. 127, 16 pages. Cold rolled C steels with .22-.60% C, Cr-Mo and stainless steel (18/8 + 1.5% Mo) have been submitted to tensile, static bending, and alternating bending tests in air at room temperature and at —20°C. and in Baltic sea water. Tests were made at the Swedish Government Testing Institute. A special testing machine was constructed for the alternating bending tests. The experimental results show that a high tensile strength is accompanied by a high fatigue limit in alternating bending, provided that decarburization or similar defects at the surface do not impair the fatigue resistance. If the micro-structure is known, the fatigue limit can be calculated with fair accuracy from tensile strength and reduction of area in a tensile test. At —20°C. the fatigue limit is somewhat higher than at room temperatures. If the specimen is immersed in sea water during the fatigue test, the fatigue limit is greatly lowered as shown by tests to 5 or 6 million cycles. In such tests even the stainless steels developed only half the fatigue limit which they developed in air. It seems probable that sensitivity of that steel to corrosion-fatigue in sea water is materially increased by severe cold rolling during manufacture. For further investigations of steels to be used for identical purposes, it is deemed sufficient to make tensile tests including reduction of area, and alternating bending tests in air at room temperature. If exposure to corrosion is anticipated, corrosion-fatigue tests should also be carried out. EF (9c)

Fatigue Tests on a "Safety" Type Hook. H. J. Gough & D. G. Sopwith. *Engineering,* Vol. 140, July 26, 1935, pages 101-102. The National Physical Laboratory carried out a number of tests on 2 types of crane hooks. Examination was made of the resistance of the hooks to cycles of repeated loading. Fracture occurred at the same position on the inside surface of the hook showing a weakness in the design. The maximum range of loading for an indefinitely large number of reversals was found to be 3¼ tons or 1.08 times the rated safe working load of the hook or 0.54 times its statutory proving load. To overcome the objectionable feature of the design the manufacturers improved the design by replacing the corner by a curve of comparatively large radius. Further tests on these hooks showed that the maximum range of repeated loading was increased to 3¾ tons or a factor of 1¼ times the rated safe-working load or 5/8 of the statutory proof load. The stresses induced by these loads were calculated and the estimated values for the first batch of hooks were found to be from 12½ to 13¼ tons/in.^{2} and for the second batch from 14½ to 15 tons/in.^{2} The fatigue limit of the material under repeated tensile testing was found to be about 18½ tons/in.^{2} Tables are given showing the results of these tests. LFM (9c)

An Electromagnetic Fatigue Tester. *Engineering,* Vol. 140, Oct. 11, 1935, page 406; Oct. 18, 1935, page 428; *Mechanical World & Engineering Record,* Vol. 98, Sept. 6, 1935, page 225. Describes and illustrates a machine developed by Salford Electrical Instruments, Limited, which is associated with the General Electric Company, London. The machine is for making life tests on sample bars of steel or non-magnetic metals. The bar is supported at its 2 nodes and is vibrated electrically so that it resonates. A very large number of stress cycles can be applied in a comparatively short time. The actual stress applied can be calculated from the modulus of elasticity by measuring the deflection of the bar at an antinode. The modulus of elasticity is determined from the frequency of the bar. LFM + WH (9c)

Fatigue Resistance of Metals (Über die Dauerfestigkeit von Metallen) Erich Gerold. *Forschungen & Fortschritte,* Vol. 11, Aug. 10/20, 1935, pages 313-314. Comparison between static and endurance testing results, effect of surface conditions on alternating bending strength (Mailänder's investigations) and corrosion fatigue. EF (9c)

9e. Spectrography

Progress in Spectrographic Analysis. A Correlated Abstract. Thomas A. Wright. *Metals & Alloys,* Vol. 6, Sept. 1935, pages 229-234; Oct. 1935, pages 289-292. 45 references. This correlated abstract is chiefly based upon 6 papers read before A.S.T.M., Detroit, June 1935. A great number of other references are given. Chief uses of this method are for the determination of traces of impurities and for controlling and following a purification process. WLC (9e)

Contributions to the Applied Spectrography in Metal-working Industries (Beiträge zur angewandten Spektrographie in metallverarbeitenden Industrieen). G. Heidhausen. *Mitteilungen aus den Forschungsanstalten des GHH-Konzerns,* Vol. 4, Dec. 1935, pages 59-70. The description of the spectrographic laboratory of the MAN-Nürnberg is to demonstrate how with simple and conveniently arranged apparatus spectrography can be used as a tool in examinations and routine testing of materials, and also for quantitative determinations in analyses. The principles of the measuring methods and the instruments are described in detail. Ha (9e)

Emission Spectrum Analysis and Its Application in Industry (De emissiespectraalanalyse en haar toepassing in de industrie). B. van Steenbergen. *De Ingenieur,* Vol. 50, Oct. 18, 1935, pages Mk33-Mk38. The principles of application of spectrum analysis to industrial problems are explained, methods to increase the accuracy of quantitative analysis and the polarisation photometer of Scheibe for rapid visual analyses are described. 7 references. Ha (9e)

The Role of the Spectrograph and of Minor Elements in Die Castings. Thomas A. Wright. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 329-337. See *Metals & Alloys,* Vol. 6, July 1935, page MA 293L/10. (9e)

The Spectrum of the Zinc Arc in Vacuum. Charles William Hetzler, Robert W. Boreman & Keivin Burns. *Physical Review,* Vol. 48, Oct. 1935, pages 656-659. 60 lines in the spectrum of the vacuum Zn arc have been observed in the wave-length range 2178 A.U. to 7799 A.U. All known solar Zn lines, including 2 not hitherto listed, are included. A suitable source for obtaining weak lines in vacuum is described. The stronger lines of the following elements were observed: Pb, Cu, Cd, Ag, Sn, Na, K, Rb, Cs, Sr, Be. The observations were made by means of the F and P interferometer, and by various gratings and prisms. WAT (9e)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Grain Changes in Polymorphic Transformations (Die Kornveränderungen bei polymorphen Umwandlungen). G. TAMMANN & W. BOEHME. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 223, Aug. 9, 1935, pages 365-368. A rule is given for change in grain size due to transformation effecting a recrystallization. If grain size increases, the original grain boundaries from the cooled melt are overstepped and if refinement occurs this is not the case. The use of the rule for a study of the dispersion of the mixture and the rôle of nuclei formation in grain refinement is illustrated first for a number of chemical compounds having a transformation. The number of nuclei formed in the cooled melt, after the transformation and after a retransformation was determined. The number of transformation nuclei formed determines the number of grains formed during the transformation. If the number of nuclei formed during the transformation is less than the crystallization from the melt, the grain size during transformation is increased, in the other case it is decreased. This is shown by the grain counts for the chemical compounds. Tests of the effect of the polymorphic transformation of Fe on its grain size are discussed. In the δ-γ transformation the grain is refined and additional refinement occurs in γ-β transformation but β has same orientation as γ grain which does not improve properties of the material. With the addition of V, W, Si, and Al to electrolytic Fe (A HEINZEL. *Archiv Eisenhuttenwesen,* Vol. 7, 1934, page 479) the δ-γ temperature is lowered and the γ-β raised thus forming the γ loop. If the mixture is kept below 0.4 of the limiting γ concentration, the grain size after the δ-γ transformation is small. Above 0.8 of the limiting γ there is no difference between the grain size after transformation and that of the cooled melt. The additions reduce the number of transformation nuclei in the δ-γ transformation. WB (10)

On the Definition of the Terms "Cast Iron" and "Steel." A. L. NORBURY. *British Cast Iron Research Association Bulletin,* Vol. 4, July 1935, Bureau Report No. 136, pages 157-163. Suggested definitions are; steels—alloys of Fe and C (other than malleable cast Fe) with or without other elements, which do not contain carbide eutectic or graphite eutectic in the microstructure; cast irons—alloys of Fe and C with or without other elements, which contain carbide eutectic (white cast Fe) or graphite eutectic (mottled cast Fe) in the microstructure; malleable cast Fe is defined as the product obtained by eliminating the carbide eutectic from solid white cast Fe by decarburization (whiteheart) or by conversion into graphite by annealing (blackheart). Pig Fe is defined as pigs of cast Fe from the blast furnace; refined pig Fe—pigs of cast Fe whose chemical analysis and structure have been modified either before solidification from the blast furnace or by treatment involving remelting. Semi-steel is considered to be inapplicable as a name and the author recommends that it be abandoned. The literature is discussed. WB (10)

Electrochemical Investigation of Solid Cadmium-antimony Alloys (Eine elektrochemische Untersuchung von festen Cadmium-Antimon-Legierungen). ARNE ÖLANDER. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, June 1935, pages 284-294. Measurements of electrode potentials of Cd-Sb alloys at 240°-290° C. were made. Results show that the maximum solubility of Sb in Cd is very small and that the region of the stable intermediary phase CdSb extends from 50 to 50.5 atomic % Cd. From the electrochemical data the heat of formation of CdSb was computed to: $Cd + Sb = CdSb - 3720$ cal/mol CdSb; the "degree of disorder" ("Unordnungsgrad") according to WAGNER & SCHOTTKY (*Zeitschrift für physikalische Chemie,* Abt. B, Vol. 11, 1930, pages 163-210), of the crystal lattice of CdSb of "rational" composition, to: $\beta = 0.00005$. The "degree of disorder" should increase with increasing temperature. A table of values of the "statistical term" of the temperature coefficient of electrode potentials at various "disorder constants," for bivalent metal ions is given, supplementing a similar table published by the author in *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 165, 1933, pages 65-78. ORS (10)

Recrystallization of Silver of Different Degrees of Purity (Über die Rekristallisation von Silber verschiedenen Reinheitsgrades). E. OSSWALD. *Zeitschrift für Metallkunde,* Vol. 27, May 1935, pages 101-104. The recrystallization temperature is defined as that temperature at which recrystallization first becomes rapid (arbitrarily—at which recrystallization is first perceptible in 10 min.). It is found that this property in Ag is profoundly affected by the presence of impurities. Using the appearance of X-ray diffraction spots as the criterion, the recrystallization temperature of four grades of Ag and Ag alloys containing 0.1 and 10% Fe and 0.2% Au was investigated. The presence of 0.04 to 0.05% Cu as an impurity increased the recrystallization temperature from 80° to 175° C; 0.2% Au in this impure Ag reduced the temperature to 170° C. and 0.1% Fe reduced it to 150° C. In the highest purity Ag, recrystallization took place after a short time at room temperature, but none occurred within five months in Ag with impurities of Cu. The behavior of the recrystallization temperature is shown to agree closely with that of recovery as studied by Tammann and Dreyer. FNR (10)

An X-ray Investigation of Certain Copper-Tin Alloys. E A. OWEN & JOHN IBALL. *Metal Industry,* London, Vol. 47, Sept. 13, 1935, pages 273-274. Abstract of paper before the Institute of Metals, Sept. 1935. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 409L/6. HBG (10)

Eutectic of the System Antimony-Lead (Sur l'Eutectique du Système Antimoine-Plomb). OTAKAR QUADRAT & JEAN JIRISTE. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 485-489. Three-kg. slowly cooled specimens of Sb with 19.55 and 12.89% Pb were used. Sb separated out into the upper part, not only in the first 2 alloy eutectics but also in the third. In the center of the first ingot which had 13% Sb or higher the segregation was not completely quantitative but the Sb crystals were encased in the eutectic, for the amount of Sb determined was on an average 11.4%. It was the same in the third ingot. Microscopic examination of the homogeneous part of the ingot shows that the Sb was completely separated out; it contained only pure eutectic. The low % Sb in this homogeneous part of the hypereutectic alloy of Sb and Pb may be explained as follows: (1) error in chemical analysis; (2) impurities in the original material; (3) influence of the method of cooling; (4) the values as given in the literature for the composition of the eutectic are incorrect. MAB (10)

A Magnetic Dilatometer. T. C. RICHARDS. *Iron & Steel Industry,* Vol. 8, Apr. 1935, pages 261-264. A new form of expansion apparatus incorporating a pendulum and a magnetic system is described. The specimen, in the form of a rod ½" in length, is situated at the closed end of a silica tube in the uniform temperature zone of a cylindrical electric furnace. Expansion is communicated by a silica tube to the pendulum. The magnified movement at the lower end of the pendulum is considerably further magnified by the magnetic system. Here the principle is that lateral displacement of an iron element in a curved magnetic field results in considerable rotation. Visual or photographic observations are made with a lamp and scale. Correction is made for unwanted expansion. The apparatus is particularly suitable for investigating the anomalies in the expansion of metals and alloys. CEJ (10)

A Study of the Thermally Disturbed Areas in Carbon Steels. A. T. ROBERTS. *Welder,* Vol. 7, Aug. 1935, pages 647-651. Changes which are produced in the base metal by the deposition of a single layer of weld metal during metallic arc welding of some C steels, were investigated. The examination of the micrographs shows that pearlite has disseminated from its original comparatively compact formation as a result of transformation and, with continued increase in temperature, of the progressive dilution of the solid solution by the conversion of an increasing quantity of ferrite to austenite. The degree of dissemination increases in all steels investigated progressively up to the Ac$_3$ point, where recrystallization occurs. The grain size of the zones heated above the Ac$_3$ points increases gradually from base material to weld junction, and the Widmanstätten type of structure of overheated steel is clearly visible in the weld junction area of a single-run weld. The minimum temperature attained in the thermally disturbed area seems to be sufficient to remove largely or even completely residual stresses. The Brinell hardness is generally reduced in the area by the stress-relieving treatment, but some degree of comparative hardness still exists in portions nearly adjacent to the weld due to more homogeneous distribution of iron carbide. 4 references. Ha (10)

Equilibrium Relations in the Copper Corner of the Ternary System Copper-tin-beryllium. E. S. ROWLAND & CLAIR UPTHEGROVE. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 190-217. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 294R/5. (10)

X-Ray Study of Electrolytic Deposits of Cadmium (Estudio Roentgenografico de depositios electroliticos de cadmio). A. RUBIO & J. GARCIA DE LA CUEVA. *Anales de la Sociedad Española de Fisica y Quimica,* Vol. 33, June 1935, pages 521-532. The authors study electrolytic layers of cadmium, obtained from electrolytes with and without colloids, at current densities varying from 1-3.5 amps./dm.^{2}. On very thin deposits an anomalous orientation appears, in which the plane $(11\bar{2}0)$ is disposed parallel to the surface of the sample and as the deposit grows thicker, the orientation appears with the plane $(112\bar{2})$ parallel to the plane of the sample. At the highest electrochemical efficiency no orientation exists and this sample shows the highest brilliancy. The size of the grain has been calculated as greater than 10^{-6} cms. FRM (10)

Magnesium-lithium Equilibrium Diagram (Gleichgewichtsdiagramm des Systems Magnesium-Lithium). P. SALDAU & F. SCHAMRAY. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 224, Oct. 18, 1935, pages 388-398. Diagram and thermal and microscopic data are given. WB (10)

The Midrib in Martensite Needles (Die Mittelrippe in Martensitnadeln). E. SCHEIL. *Archiv für das Eisenhüttenwesen,* Vol. 9, July 1935, page 61. On deforming martensite needles it is shown that they deform as whole units. The familiar "midrib," therefore, does not appear to be caused by a difference in orientation between the separate parts of the martensite needle. A satisfactory explanation is still lacking. SE (10)

Induction Period of the Austenite Transformation (Anlaufzeit der Austenitumwandlung). E. SCHEIL. *Archiv für das Eisenhüttenwesen,* Vol. 8, June 1935, pages 565-567. The time for the appearance of transformation nuclei controls the degree of suppression of a transformation. This can be calculated from the effect of the cooling rate on the transformation. As nuclei for ferrite formation, sulphides have the strongest effect, then come grain boundaries, and dark oxides have a negiligible effect. SE (10)

Appearance of a High Power of Crystallization in the Formation of Iron-Zinc-Alloys (Über das Auftreten einer hohen Kristallisationskraft bei der Bildung von Eisen-Zink-Legierungen). E. SCHEIL. *Zeitschrift für Metallkunde,* Vol. 27, Apr. 1935, pages 76-77. A prism of Fe held in a bath of molten Zn at a temperature between 450 and 480° C. will form a thick Zn-rich surface layer which grows perpendicularly to the surfaces of the Fe specimen forming parallelopiped shaped blocks on each face. The blocks are composed of two layers, one fine grained adjacent to the Fe and the other coarse grained, both being made up of an aggregate of FeZn$_7$ and Zn. The FeZn$_7$ forms as plates nearly parallel to the direction of growth. In unrestrained growth the rate of increase in thickness of the layer is linear with time at least up to 6 mm. (3 hrs.). The rate of growth is decreased, though still nearly linear with time, on the interface between two Fe blocks held together under mechanical pressure, the restraining influence of the pressure being greater at higher than at lower temperatures. A power of crystallization of 6 kg./mm.^{2} was observed at 450° C. FNR (10)

Transformations in Irreversible Iron-Manganese Alloys (Beitrag zur Kenntnis der Umwandlungen in irreversiblen Eisen-Mangan-Legierungen). E. SCHEIL. *Archiv für das Eisenhüttenwesen,* Vol. 9, Aug. 1935, pages 115-116. Dilatometer measurements of Fe-Mn alloys with 7-12% Mn indicated that the transformation which H. Scott ascribed to an α-γ change was in part an ϵ-γ change, the former being associated with an expansion, the latter with a contraction. In this composition region the two transformations overlap. SE (10)

Rate of Polymorphous Transformations. III. Effect of Mechanical Deformation on the Rate of Transformation (Die Geschwindigkeit polymorpher Umwandlungen. III. Einfluss mechanischer Deformation auf die Umwandlungsgeschwindigkeit). Ernst Cohen, W. A. T. Cohen-de Meester & A. K. W. A. van Lieshout. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, June 1935, pages 169-177. The rate of the transformation of white Sn to gray Sn is increased by rolling, drawing, or bending of the specimen. It increases greatly with increasing degree of mechanical deformation and decreases greatly upon annealing of the mechanically deformed specimen. These facts support and are explained by the theory of the mechanism of polymorphous transformations described in *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, 1935, pages 1-31.
ORS (10)

Recrystallization and Grain Growth in Cold-Worked Polycrystalline Metals. L. W. Eastwood, Arthur E. Bousu & C. T. Eddy. *Metals Technology,* Oct. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 644, 19 pages. Tapered specimens of 66-34 brass were elongated and heated to different temperatures for different times. Influence of annealing was studied by measurements of Rockwell hardness and grain size. The grain size after complete recrystallization was dependent only on composition and history of the material prior to deformation and on the degree of deformation. It was concluded that all grain growth obeys the same laws, germination as such being nonexistent since there is no discontinuity in the size of the new grains produced. Abnormality of grain growth was not produced by temperature gradients. The large grains produced by annealing metals containing low degrees of strain are due to the large grains formed on recrystallization rather than to the absorption of grains by "germinant" grains produced by a critically strained metal at a "germinant" temperature. Annealed cold-worked metals that do not have an allotropic transformation have coarser grains with higher annealing temperature since rapid heating through the so-called germinant temperature to a higher temperature produces a coarser grain rather than a finer one.
JLG (10)

Growth of Gray Iron (Il Phenomeno dell' "Accrescimento" nella Ghisa Grigia). V. S. Prever. *Industria Meccanica,* Vol. 17, Aug. 1935, pages 685-689. Theories on growth of gray iron are reviewed, crystalline changes and recrystallization described and the effect explained as due to decomposition of cementite and formation of graphite.
Ha (10)

Initial Stages of the Magnetic and Austenite Transformations in a Carbon Steel. I. N. Zavarine. *Metals Technology,* Oct. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 646, 6 pages. A wire of eutectoid steel was passed from a spool through a furnace, then through a salt bath heated to about 200° C., then through an X-ray diffraction camera, and finally through a transformer. Results indicated that the lattice transformation of the steel quenched into a hot bath does not coincide with the magnetic transformation, the lattice transformation preceding the magnetic transformation. 7 references.
JLG (10)

An Investigation of the Zinc-rich Portion of the System Iron-zinc. E. C. Truesdale, R. L. Wilcox & J. L. Rodda. *Metals Technology,* Oct. 1935, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 651, 37 pages. New values for the solubility of Fe in high-purity Zn were obtained by 3 direct sampling methods at temperatures between 425 and 875° C. These data are lower than all previously published values, obtained from primary cooling curve arrests. The solid solubility of Fe in Zn was investigated by microscopical, electric conductivity, X-ray, and magnetic susceptibility methods, but only the microscope gave useful results. The eutectic temperature was determined from differential cooling curve arrests. The 2 peritectic temperatures were relocated at new high values by cooling curves, but principally by heating curves that were more accurate. The Zn-rich portion of the diagram was fixed as follows: Solid solubility of Fe in Zn, between 0.0009 and 0.0028%; m. p. of Zn, 419.45° C.; eutectic temperature, not less than 419.40 ± 0.05° C.; lower peritectic, 672 ± 1° C.; upper peritectic, 782 ± 1° C.; solubility of Fe in molten Zn, 0.018% at 419.4° C., 3.0% at 672° C., 7.4% at 782° C., 9.2% at 875° C. All previous data dealing with the Fe-Zn system are critically reviewed and the equilibrium diagram is brought up to date. 34 references.
JLG (10)

The Habits and Laws of Decomposition of Supercooled Solutions, with Special Regard to Austenite. G. B. Upton. *Pennsylvania State College, Bulletin* No. 18, 1935, pages 24-58. See *Metals & Alloys,* Vol. 5, Dec. 1934, page MA 581.
AHE (10)

Magnetism and Atomic State of Metallic Solid Solutions (Magnetismus und Atomzustand metallischer Mischkristalle). E. Vogt. *Zeitschrift für Metallkunde,* Vol. 27, Feb. 1935, pages 40-43. By the interpretation of available data on the magnetic susceptibility of the alloys of the continuous solid solution systems between Au, Ag and Cu and the transition elements (Cr, Mn, Fe, Co, Ni, Pd, Pt) it is concluded that the ionization and quantum state of a species of atom is not the same in all alloys and is dependent upon the nature of the alloying partner. It appears possible that the transition elements do not always have the same valence electron number in the Hume-Rothery compounds. The Hume-Rothery rule is certainly followed if the valence is zero as may occur at low concentrations of Ni, Pd and Pt (each with 10 outer electrons) in Au, Ag and Cu, but the elements before Ni (with less than 10 outer electrons) appear to dissolve in a univalent or bivalent form. The data upon which these conclusions are based are presented in a graphical summary.
FNR (10)

Solubility of Sodium in Aluminum (Versuche über die Löslichkeit von Natrium in Aluminum). E. Scheuer. *Zeitschrift für Metallkunde,* Vol. 27, Apr. 1935, pages 83-85. The solubility of Na in molten Al and alloys of Al-Si, Al-Cu and Al-Mg was measured by quenching the metal contained in a closed iron crucible and protected with a H_2 atmosphere. Approximate average solubility values follow: Al (0.1% Si, 0.2% Fe) at 700° C. dissolved 0.1% Na, at 750° C.—0.18% Na, and at 800° C.—0.29% Na; Al-Si 13% (0.4% Fe, 0.1% Si) at 600° C. dissolved 0.08% Na, at 700° C.—0.12% Na, at 750° C.—0.125% Na, and at 800° C.—0.11% Na; Al-Cu 8% dissolved at 700° C. about 0.15% Na and at 800° C.—0.18% Na; Al-Mg 5% dissolved at 700° C. about 0.17% Na and at 800° C.—0.21% Na. The individual measurements showed a wide deviation from the values quoted above. A dark gray to black Na-rich microconstituent was found in the alloys.
FNR (10)

Copper Amalgam CuHg with the Structure of γ Brass (Das Kupferamalgam CuHg mit der Struktur des γ-Messings). Fritz Schloszberger. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29, June 1935, pages 65-78. Two new methods of preparation of CuHg crystals are described. The crystal lattice of CuHg is cubic of the γ-brass type, a = 9.406 ± 0.004 A.U. The ratio: Cu atoms/Hg atoms is definitely 1:1, so that Hume-Rothery's rule concerning the ratio of the number of valence electrons to that of atoms appears to be invalid in the case of CuHg. Attempts to arrange Cu atoms and Hg atoms in a manner analogous to the arrangement of Cu atoms and Cd atoms in the lattice of Cu_5Cd_8 led to several discrepancies in interatomic distances and between computed and observed intensities of X-ray interference lines such as exist, in a lesser degree, also with the structures of Cu_5Zn_8 and Cu_5Cd_8. A revision of the concept of the γ brass structure appears to be necessary.
ORS (10)

Detection of Lattice Disturbances by X-rays in Cold Worked Nickel (Röntgenographischer Nachweis von Gitterstörungen in kaltverformtem Nickel). W. E. Schmid & Ernst A. W. Müller. *Zeitschrift für technische Physik,* Vol. 16, June 1935, pages 161-164. Similarly as with Fe and Cu, the width of interference lines of X-ray spectrograms of cold worked commercially pure Ni is approximately proportional to the external stress causing the deformation. The values of internal stresses computed from the measured widths of the interference lines do not agree, either in magnitude or in their dependence on the elongation of the deformed specimen, with the values determined by Kersten (*Zeitschrift für Physik,* Vol. 82, 1933, pages 723-728) from measurements of the initial magnetic permeability.
ORS (10)

Specific Heats at Low Temperatures (Untersuchungen über die spezifischen Wärmen bei tiefen Temperaturen). F. Simon & R. C. Swain. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 28, Mar. 1935, pages 189-198. The specific heat of Fe, Li, Al_2O_3, $CaCO_3$, activized charcoal, and adsorbed A within various temperature intervals between 13° and 300° abs. has been determined. An anomaly in the specific heat of Li suggests the occurrence of a thermally excited quantum leap.
ORS (10)

Studies of Phase Changes During Aging of Zinc Alloy Die Castings. II.—Changes in the Solid Solution of Aluminum in Zinc and Their Relation to Dimensional Changes. M. L. Fuller & R. L. Wilcox. *American Institute Mining & Metallurgical Engineers,* Mimeographed Copy, Oct. 1935, 16 pages. A Zn-rich alloy containing 4% Al and 0.04% Mg (made from high-purity Zn) was studied. Expansion of die-cast parts on aging was measured and the parameter of the Zn rich phase on aging was determined by X-ray diffraction. It was found that the actual dimensional changes that occur during normal aging are accounted for in a semiquantitative way by changes in the Zn-rich (α) phase and that in this alloy the β transformation contributes very little, if any, to the shrinkage experienced. The charge in the α phase is precipitation of an Al-rich phase, which can be redissolved on heating to 175° C. Commercial stabilization, which consists in heating at 95° C., brings about relatively rapid precipitation of the Al-rich phase. Appendix A gives the lattice parameters of Zn-rich Zn-Al alloys containing up to 2.2% Al. Appendix B gives data on the solid solubility of Al in Zn. Appendix C gives the measured interplaner spacings and lattice values calculated from them for various specimens used in the investigation.
JLG (10)

Constitutional Diagram for Quaternary Alloys (Ein Zustandschaubild für Vierstofflegierungen). V. Fischer. *Zeitschrift für Metallkunde,* Vol. 27, Apr. 1935, pages 88-89. A system for the representation of quaternary composition points with the corresponding reaction temperatures upon plane orthogonal axes is presented. The method is analogous to the representation of ternary diagrams by means of t-x sections, but a larger amount of data is recorded upon each section, thus reducing to a small number the sections necessary to establish a complete diagram. As an illustration, 2 sections of the liquidus and solidus of the Mn-Cu-Fe-Ni system are worked out and described in detail.
FNR (10)

The Piobert Effect in Iron and Soft Steel. Eric W. Fell. *Iron & Steel Institute,* Advance Copy No. 3, Sept. 1935, 17 pages. When a bar of highly polished soft steel is subjected to increased tensile stress a value of stress is reached at which the bar may suddenly yield to a remarkable amount with permanent surface distortion easily recognized as characteristic. The distortion is called the Piobert effect. A careful consideration of published observations indicated that the effect is not observed in non-ferrous metals. The spread of the effect through the bar is progressive and occurs at nearly constant stress. It may thus be compared with the spread of solidification at constant temperature in the mass of a pure metal near its melting point. The flow associated with the Piobert effect was studied by stressing ruled test pieces. A distorted domain is divisible into smaller domains in each of which slip may be one of two kinds. In the simpler kind the slip seems constant in magnitude and direction. In the other kind the magnitude of slip in a certain direction varies. The resultant slip is generally not parallel to the surface of the test bar. The change in shape of the test bar after removal of the stress may be regarded as the sum of the changes in the smaller domains. The distortion results from shear. Propagation of the effect is probably due to stress concentration. 37 references.
JLG (10)

The Theory of Galvanic Potentials. I. Ph. Gross & O. Halpern. *Journal of Chemical Physics,* Vol. 3, Aug. 1935, pages 458-460. A thermodynamic study of the theory of galvanic electrode potentials is presented. It is shown, starting from strictly equilibrium conditions, that the series of normal electrode potentials can be expressed through other partly known thermodynamic quantities, one group of which refers to the solid phase only, independent of the solvent used, while the other is characterized by the type of the solvent.
WH (10)

Effect of Ferromagnetic Transformation on Catalytic Effect of Nickel on Reaction $2CO = CO_2 + C$ (Über den Einfluss der ferromagnetischen Umwandlung auf die Katalysierfähigkeit von Nickel in bezug auf die Reaktion $2CO = CO_2 + C$). J. Arvid Hedvall & Folke Sandford. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29. Sept. 1935, pages 455-463. The relation between the magnetic state of Ni and its catalytic effect on the reaction $N_2O = N_2 + \frac{1}{2}O_2$, described in *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 27, 1934, pages 196-208, applies also to the reaction $2CO = CO_2 + C$ and seems to be a direct one. The catalytic effect of Ni is greatly affected by dissolved or otherwise absorbed gases. The position and length of the temperature interval of the magnetic transformation (Curie interval) of Ni are affected by impurities to a considerable degree.
ORS (10)

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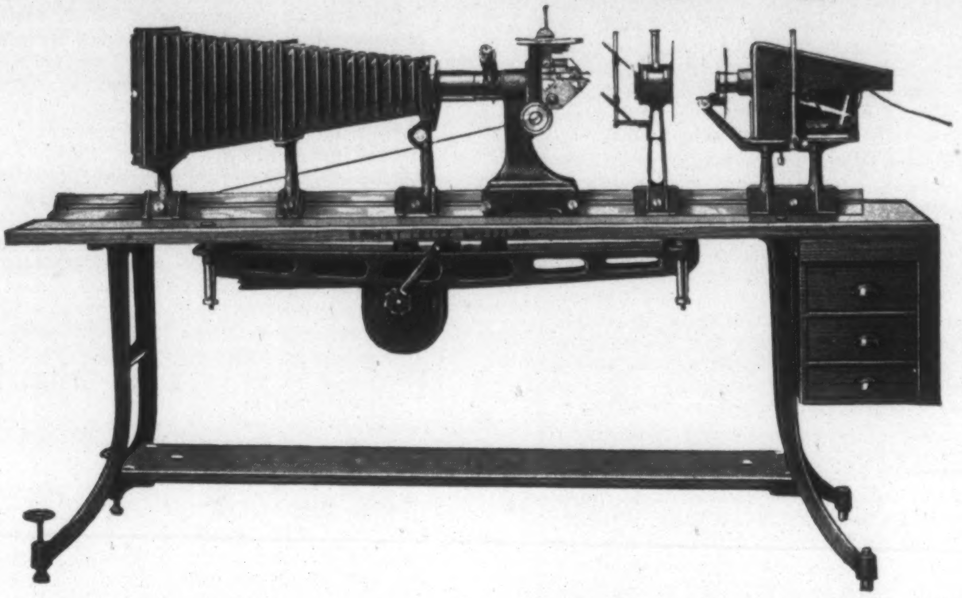

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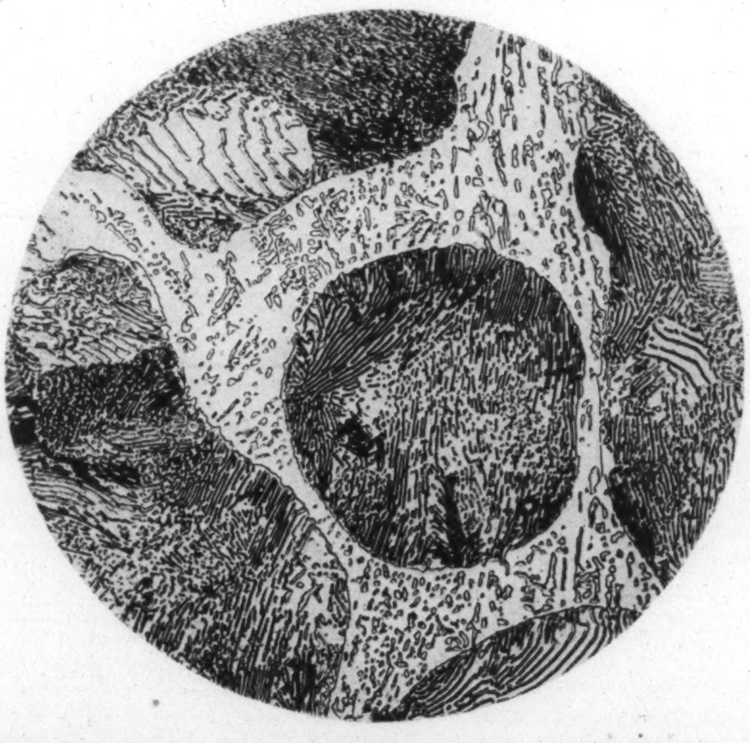

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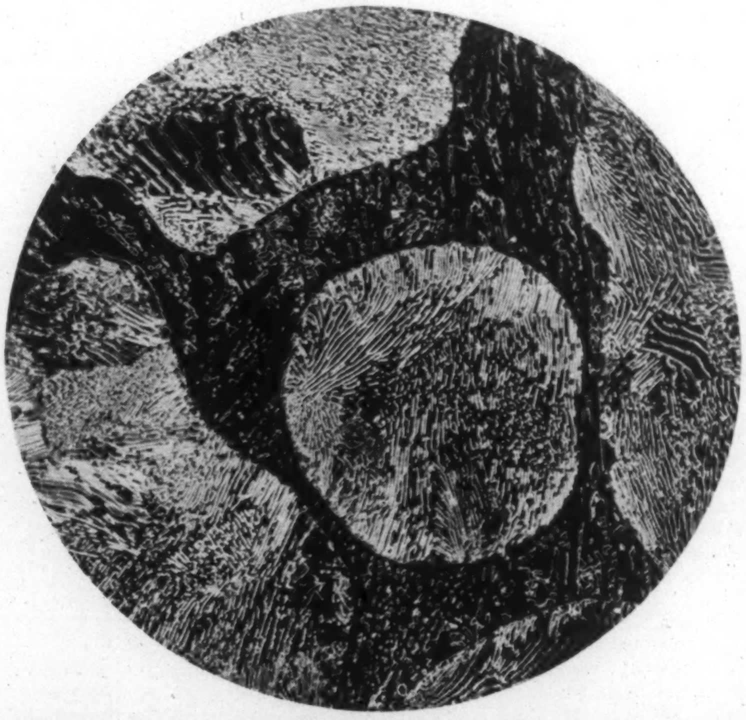

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The Special Condition of Matter in Certain Alloys, Considered as Spatial Chemistry (Der besondere Zustand der Materie in gewissen Legierungen, raumchemisch betrachtet). WILHELM BILTZ & FRIEDRICH WEIBKE. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 223, Aug. 9, 1935, pages 321-361. In previous work it had been shown by calorimetric measurements that under comparable conditions a base metal is bound in an intermetallic compound with greater affinity than a noble metal. The space decrement of the atoms due to compound formation is constant for the particular atoms and is practically independent of the amount and type of the accompanying metal in the compound. The electron volume was determined as the difference between the volume of atoms and ions. This is considered to be a term similar to the mechanical compressibility of metals, as a shrinkage of the electron space occurs in the formation of a metallic compound due to the combination of base and noble metals forming positive particles with high field effect. The author calls this chemical compression. The special condition of matter in the compounds is defined by the amount of shrinkage in space, for example in the combination of Ag with 3 alkaline earth metals the space shrinkage of the metals was independent of the amount of Ag. Results for the paper were obtained by pycnometer and X-ray measurements and calculated to the same reference temperature of absolute zero. There is given the mathematical determination of space changes for intermetallically bound particles, presentation of the basic laws, graphic evaluation of various ranges of substitution solid solutions, limiting conditions for the basic law with complete tables of the space changes for several series of compounds, evaluation of the test results and description of the special condition of matter in the alloys investigated based on the electron theory of metals. Experimental details are included. A great number of tables are given for the data as found and calculated. WB (10)

Morphology of the Inclusions in Siderurgical Products. A. M. PORTEVIN & RENÉ CASTRO. *Iron & Steel Institute,* Advance Copy No. 13, Sept. 1935, 38 pages. Attention is drawn to the value of the study of inclusions in tracing the previous history of the material containing the inclusions. Microscope technique and analyses for inclusions are discussed. In the second part of the paper inclusions that can be formed in C steels are discussed in detail. The steels studied contained Mn, Si or Al either together or separately. In each case the type of inclusion exhibited by 0, S or 0 and S together is discussed. Characteristic appearances of the inclusions are shown in a series of 110 micrographs, each of which is mentioned in the text. JLG (10)

The Transformation in the Copper-gold Alloy Cu_3Au. C. SYKES & H. EVANS. *Journal Institute of Metals,* Vol. 58, Oct. 1935, pages 443-472 (Advance Copy No. 716). The effect of transformation in the alloy Cu_3Au on electric resistance, X-ray structure, and specific heat was investigated. The general character of the transformation is satisfactorily predicted by the Bragg-Williams theory of formation of superlattices by atomic rearrangement. The atomic rearrangement process involves first the formation of small nuclei having a relatively high degree of order. The nuclei then grow to a size approximating that of the individual crystals if a constant temperature is maintained. If the alloy is continuously cooled before it attains equilibrium, 2 processes proceed simultaneously—nuclei to grow and the degree of order in the nuclei to increase owing to the reduction of temperature. The existence of such nuclei is not considered in the statical theory of superlattices, so that it is not surprising to find that the theoretical predictions regarding the rate of relaxation into the equilibrium state are not in agreement with experiment. 12 references JLG (10)

Equilibrium Diagram of the Silver-rich Aluminium Alloys, with a Note on the Nature of the Transformations. ICHIJI OBINATA & MASAMI HAGIYA. *Kinzoku no Kenkyu,* Vol. 12, Sept. 1935, pages 419-429. In Japanese. The Ag-Al diagram from 0 to 11% Al, has been revised from results of X-ray, electric-resistance, and microscopic analyses. Alloys containing 5, 7 to 8, and 2% Al undergo the eutectoid and the metatectic transformation, the temperatures of which are found to be 615° and 420° respectively. While the metatectic transformation can easily be suppressed by water quenching, complete suppression of the eutectoid transformation is hardly possible. Thus the alloys quenched from the β field consist of γ phase, supersaturated with Ag, showing by X-rays the hexagonal-close-packed lattice. On heating the quenched hypoeutectoid alloys, an anomalous increase of resistance was observed at about 200°, the cause of which is considered probably to be the formation of Ag_3Al. The crystal structure of the β phase has been determined by means of X-ray analysis at high temperatures. As is expected, this phase is body-centered cubic with $a = 3.295$ A.U. at 700° ($Al = 7.98\%$). KT (10)

The Crystal Structure of Metals—A Review of Recent Researches. *Metal Industry,* London, Vol. 46, June 21, 1935, pages 669-670. It has been known that, while some crystal properties conform to the dimensions predicted from the lattice theory, many properties have values much lower than those calculated from theory. Mosaic, secondary, and lineage structures are theories suggested as possible causes for these lowered values but investigators differ in interpretation of results. The theories of crack broadening and of the plasticity of crystals are also discussed. 10 references. HBG (10)

Studies Upon the Widmanstätten Structure, VII—The Copper-silver System. CHARLES S. BARRETT, HERMAN F. KAISER & ROBERT F. MEHL. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 39-60. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 295R/9. (10)

Note on the Tarnishing of Liquid Metals as Studied by X-rays. HUGH O'NEILL & G. S. FARNHAM. *Journal Institute of Metals,* Vol. 57, Aug. 1935, pages 407-412 (Advance Copy No. 713). An apparatus was constructed for the X-ray study of liquid metals up to 700° C. by surface reflection. Spectrograms taken with Cu radiation in an atmosphere of H just above the m.p. of Pb, Sn, and SnSb showed the structure of surface-tarnish films. Preferred orientation effects were observed. On heating to higher temperatures the tarnish was reduced in thickness, and the Debye ring of the liquid metal replaced the X-ray spctrum of the tarnish. JLG (10)

Hard and Soft Copper Wire. R. A. SCHATZEL. *Wire & Wire Products,* Vol. 10, Sept. 1935, pages 382-396, 450. Metallurgical and metallographic principles. Ha (10)

11. PROPERTIES OF METALS AND ALLOYS

Characteristic Behavior of Elasticity Modulus of Ferromagnetic Materials (Das Sonderverhalten des Elastizitätsmoduls ferromagnetischer Werkstoffe). M. KERSTEN. *Zeitschrift für Metallkunde,* Vol. 27, May 1935, pages 97-101. The theory of magnetic domains, as developed by Weiss and Heisenberg, is described simply, especially with regard to magnetostriction. It is shown that the deviations from Hooke's law which occur in ferromagnetic materials, even in the absence of an external magnetic field, may be explained upon this basis. Likewise the theory explains the experimentally determined variations of the elasticity modulus of Ni and their dependence upon cold work and external field. By applying the theory to the temperature coefficient of the elasticity modulus, the change found at the Curie point for Ni is explained, and a reasonable picture is provided for the behavior of Elinvar. GD (11)

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Cerium Used in New Ni-Al Alloy. *Automotive Industries,* Vol. 73, Aug. 17, 1935, page 206. Ceralumin C, an aluminum base alloy being commercially produced by J. Stone & Co., London, is discussed. See *Metals & Alloys,* Vol. 6, Jan. 1935, page MA 33R/2. BWG (11a)

New Copper Alloy Has Unusual Properties. *Automotive Industries,* Vol. 73, July 29, 1935, page 81. Announcement is made by P. R. Mallory & Co. of Indianapolis, Ind., of the development of a high strength Cu base alloy having, as forgings or rod, an electrical conductivity of 80-85% that of Cu. Sand castings have 75-85% of the conductivity of forged Cu. It is being extensively used for spot welding tips, flash welding dies, and seam welding wheels. Composition of alloy is not given. BWG (11a)

Methods of Manufacture and Their Influence on Design of Aluminum Alloy Wrought and Cast Parts. W. C. DEVEREUX. *Metal Industry,* London, Vol. 45, Nov. 23, 1934, pages 489-493; Nov. 30, 1934, pages 513-516. See *Metals & Alloys,* Vol. 6, July 1935, page MA 298R/1. HBG (11a)

Gold-Copper Alloys (Ueber die Gold-Kupfer-Legierungen). M. LEBLANC & G. WEHNER. *Annalen der Physik,* Series 5, Vol. 5, Aug. 1935, page 570. Discrepancies in the results of investigations of properties of Au-Cu alloys by other authors are ascribed to lack of equilibrium. Ha (11a)

Metal Compounds which Disintegrate (Über zerrieselnde Metallverbindungen). G. TAMMANN & AD. RUHENBECK. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 223, June 28, 1935, pages 288-296. It had been noted that some metal samples when left standing in the laboratory for a time, disintegrated to a powder. In the dry air of a desiccator the disintegration is assumed either not to occur or to take place at a very low rate. When an alloy containing some crystals of these compounds is polished for micro-examination the compounds with higher rates of disintegration decompose on the polished surface when exposed to moist air and disappear from the surface leaving a powdery substance in their place. In an Al-Sb regulus containing 50% Al the disintegration in 6 years had proceeded to a depth of 6 mm. from the surface. On the polished surface the Al-Sb compound had disintegrated to a black powder. The metals which form compounds susceptible to this sort of disintegration have been observed to be Al, Ca, Mg, Ce and Si. The following table is used to show the binary compounds of this type;

Al	Fe,Ni,Co,Mn,Cr,Sb
Ca	Ag,Cu,Pb,Tl
Mg	Pb,Sn,Tl,Cd,Sb,Bi
Ce	Sn,Al,Si,Bi,Mg,Fe
Si	Fe,Mn,Cu

The disintegratible compounds are discussed in detail further in the paper in the order given in the above table. Tables are given of the formulas of the compounds formed with Al and those which disintegrated in 27 years storage in cardboard paper boxes are indicated as; $FeAl_3$, Fe_2Al_5, $NiAl_2$, Co_3Al_{13}, Co_2Al_5, $MnAl_3$ (?), $AlCr_3$, AlSb. In the commercially important Cu-Al alloys no disintegration has been observed and Sn,Pb,Cd and Bi do not form compounds with Al and the alloys have no tendency to disintegrate. The Ca compounds which disintegrate are given in a table as; AgCa, $AgCa_2$(?), Cu_4Ca, Pb_3Ca, PbCa, $PbCa_2$, Tl_3Ca, Tl_4Ca_3, TlCa. The percent of Ca range in which the metal mixtures disintegrate are given. The Ag-Ca alloys from 0-12% Ca do not decompose water, from 12-16% Ca the action is weak and from 16-100% Ca there is violent decomposition of the water. The Pb-Ca compounds are so active that they can be kept intact for only a month in a desiccator. The Mg compounds that disintegrate are $PbMg_2$, $SnMg_2$, Tl_3Mg_8, $TlMg_2$, Tl_2Mg_3, CdMg, Bi_2Mg_3, Sb_2Mg_3. Compounds such as $NaZn_{11}$ or KZn_{12} are cited as being disintegratible according to previous literature. The Ce compounds which disintegrate to powder are Ce_2Sn, Ce_2Sn_3, $CeSn_2$, Ce_3Al, Ce_2Al, CeAl, $CeAl_2$, $CeAl_4$, $BiCe_3$, Bi_3Ce_4, BiCe, Bi_2Ce. The role of Si is shown to be to make susceptible to disintegration otherwise stable binary compounds when the Si is added as a third element. The tables cited above also give the compounds that are stable and do not disintegrate to powder. Another table is given showing that unstable compounds may be formed by the combination of noble and base metals and stable compounds may be formed by the same combination thus ruling out an electrochemical basis for the disintegration process. For example Mg forms with Al and Zn and with Cu, Ag and Au stable compounds that do not disintegrate. The theory is advanced that where a stable binary compound of a noble metal occurs, with a base metal which ordinarily gives rise to disintegration when combined, the disintegration does not proceed because the noble metal may after a short time be exposed as a chain of atoms at the surface due to the removal of the base metal atoms. Such a noble metal surface formation is assumed to prevent further disintegration. WB (11a)

Length Variation of Nickel on Quenching. H. Goulbourne Jones. *Metallurgia,* Vol. 12, July 1935, page 86. Ni cylinders were quenched from approximately 525° C. and their length after standing subsequent to quenching determined by an optical lever. Length changes observed could not be correlated with hardness changes observed by Herbert. JLG (11a)

Making and Testing Single Crystals of Lead. B. B. Betty. *Preprint, Meeting American Society for Testing Materials,* June 1935, 8 pages. The creep characteristics have been determined for specimens composed of only one crystal to eliminate the effect of movement at the grain boundaries, which together with the deformation of the grains themselves, appear to determine the creep in polycrystalline Pb. The method of casting the crystals, including the temperature and temperature gradient control necessary, is described. An inexpensive, rapid and sufficiently accurate optical method of determining the crystallographic orientation of the crystals is presented, which obviates the necessity of the laborious and time-consuming X-ray method. Tests to date show that the strain-time diagrams for single crystals of commercially pure Pb are quite different from those of polycrystalline specimens of the same material. The mechanism of creep in single-crystal specimens of commercially pure Pb seems to be by slip on that octahedral plane on which the resolved shearing stress is a maximum. There are some grounds for believing that there is a limiting resolved shearing stress (approx. 250 lbs./in^2) on the octahedral planes below which creep takes place exceedingly slowly, if at all, and above which it may proceed fairly rapidly. This apparent limiting shearing stress is somewhat higher than the lowest shearing stress at which creep has been observed in polycrystalline extruded Pb. VVK (11a)

Some Copper Alloys Containing Silicon (I). Tomojiro Tanabe & Goro Koiso. *Tetsu-to-Hagane,* Vol. 21, July 25, 1935, pages 575-584. In Japanese. Compositions and properties of various Cu alloys containing Si are shown. These properties were determined on wrought and fully annealed specimens.

Alloys	Cu	Zn	Si	Al	Ni	Mn	Fe	Sn	P	Cd
Silzin-B No. 9	86	10	4							
Ditto, No. 11	85	10	5							
Ditto, No. 17	80.5	15	4.5							
S S Z — 1*	85	10	4	1						
S S Z — 2*	84	10	4	2						
S S Z — 3*	80.5	15	3.5	1						
Tombasil	81	15	4							
Tungum	82	14	1	1	1					
P. M. G.	92	2	4			0.5	1.5		0.1	
A. R.	95.9		3					1		0.1
Everdur	96		3			1				
Herculoy	95.8	1	2.5					0.7		

* Containing minute quantities of As and P.

Alloys	Strength kg./mm.^{2}	Elong. (50 mm)%	Brinell hardness (10-500)	Izod value mkg./cm.^{2}	sp. gr.
Silzin-B, no. 9	48	55	92	15.4	8.48
Ditto, No. 11	58	34	123	9.8	8.28
Ditto, No. 17	65	41	132	8.6	8.28
S S Z — 1	55	56	104	13.7	8.27
S S Z — 2	65	35	132	8.4	8.14
S S Z — 3	58	55	107	8.4	8.28
Tombasil	60	27	145 (10-1000)	—	—
Tungum	40	73	—	—	8.41
P. M. G.	49	42	112	8.8	8.47
A. R.	42	70	75	13.5	8.61
Everdur	40	69	73	—	8.46
Herculoy	41	65	74	11.4	8,60

TS (11a)

Brass and Its Abrasion Properties as Compared with Bronze. P. F. Svirin. *Vestnik Metallopromishlennosti,* Vol. 14, Dec. 1934, pages 102-106. In Russian. Experiments conducted in a Moscow laboratory with an alloy containing 55.60% Cu, 0.60% Sn, 1.30% Fe, 0.50 Mn, rest Zn showed its wear resisting properties. The metal was checked as a bearing material for machinery used in volume production and was found to be fully equal to bronze as far as resistance to abrasion wear was considered. (11a)

Average Value to Be Assigned to the Temperature Coefficient of Electrical Resistance of Aluminum Conductors (Sul valore medio da assegnare al coefficiente di temperatura della resistenza elettrica dei conduttori d'alluminio). O. Scarpa. *Alluminio,* Vol. 4, May-June 1935, pages 145-148. The best value, for international use, of the temperature coefficient of electrical resistance of hardened Al is + 0.00405, referring to the resistivity of Al at 20° C. This is an average value for the temperature interval 0°-70° C. Thus, the resistance at "t" may be calculated as $r_t = 2.840(1 + 0.00405(t - 20) \frac{l_{20}}{S_{20}})$ in microhms; where 2.840 is the most probable value for the resistivity at 20° C. of hard-drawn wire conductors, l_{20} is the length in cm., and S_{20} the area in cm.^{2} of the conductor at 20° C. Annealed Al varies from the above as its temperature coefficient is 0.0041, so that its resistivity may be calcd. as $\rho_t = 2.777\ (1 + 0.0041(t - 20))$ microhms/cm.; i.e. the resistivity at 20° C is 2.777 for Italian Al annealed under conditions to give max. conductivity—i.e. 4 hrs. at 250° C. AWC (11a)

The Contamination of Platinum by Graphite. L. J. Collier, T. H. Harrison & W. G. A. Taylor. *Transactions Faraday Society,* Vol. 30, Aug. 1934, pages 581-587. Contains bibliography. The effect of heating Pt *in vacuo* in a C crucible, was studied and freezing point was found to be lowered 40° K, and was constant at 2007 ± 3° K. About 1.2% C was present in the Pt. Spectroscopic analyses showed traces of Mg, Ca, Fe, and minute traces of Si. These same elements were found in the graphite crucible, which also contained V. The microphotograph suggests a eutectic mixture of C and Pt. X-ray studies revealed the hexagonal pattern of graphite and the cubic structure of Pt which was distorted and increased in size 0.11% from 3.9142x10^{-8} cm. to 3.9185x10^{-8} cm. This was attributed to C dissolving in the Pt to ¼%. No compound of Pt and C was found. PRK (11a)

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The Precious Metals—Gold, Silver and Platinum. Edmund Downs. *Metal Industry,* London, Vol. 46, Mar. 22, 1935, pages 323-325; Mar. 29, 1935, pages 359-361; April 5, 1935, pages 386-388. Paper read at a meeting of the Midland Metallurgical Societies in Birmingham on Feb. 28, 1935. Gives an historical survey of each metal, discusses their present sources, processes of their production and their various applications. HBG (11a)

Beryllium-Copper Alloys. F. G. Benford. *General Electric Review,* Vol. 38, June 1935, pages 297-299. Reviews methods of hardening Cu, particularly Cu Be alloys. The disadvantages of the normal Cu Be are its high price and its low conductivity. A small percentage of Co lowers the solubility of Be in Cu at room temperature. The cost of the alloy is lessened and the conductivity is improved. Various ternary alloys of Cu-Co-Be have been standardized. Uses for these alloys include springs, soldering-iron tips, and welding electrodes. CBJ (11a)

"K" Monel Metal. *Journal of Commerce, Shipbuilding & Engineering Edition,* June 13, 1935, page 2. This alloy is prepared by the addition of Al to, and the careful adjustment of, the composition of Monel metal. It retains the characteristic corrosion resistance of Monel metal; can be rendered hard (260 Brinell) or soft (150 Brinell) by suitable heat-treatment; and is non-magnetic under ordinary working conditions, remains so at sub-normal temperatures and shows no measureable difference in magnetic permeability between its soft and fully hardened condition. JWD (11a)

Simple Means to Distinguish the Different Aluminum Alloys (Einfache Mittel zur Unterscheidung der verschiedenen Aluminium-Legierungen). E. Zurbrügg. *Aluminium,* Vol. 17, Oct. 1935, pages 531-533. The alloys of the type Al-Mg-Si, Al-Mg and Al-Mg-Mn which cannot be distinguished by chemical methods (and also not by those described previously by Zeerleder and Bosshard in *Aluminium,* 1934, pages 88-92 and 1935, pages 13-15) are distinguished from one another by hardening tests in conjunction with scratch or ball tests. Procedures are described in detail. Ha (11a)

British Non-Ferrous Metals Research Association. *Metal Industry,* London, Vol. 46, June 21, 1935, pages 677-680. The fifteenth annual report of the Association was presented at the annual meeting on June 18. This includes a report of the Research Program Committee who had correlated the many suggestions offered, selected a limited number of the more important ones from each group and placed them in an order of priority. New researches for 1935 are (1) melting and casting of bronzes, (2) casting of nickel silver, (3) surface finish of rolled brass, (4) effect of Sb on soft solders, (5) corrosion of Pb, (6) influence of Al on corrosion, oxidation and scaling of brasses of different Cu contents, (7) creep of non-ferrous metals and alloys, (8) effect of cold working and heat treatment on elastic properties of metals and alloys. Investigations terminated during 1934 included the effect of impurities on the properties of Cu and properties of Pb. Progress was reported on (1) metallurgical applications of the spectrograph, (2) Al castings, (3) improvement of Sn coatings, (4) alloys for high temperature service, (5) condenser tube corrosion, (6) effect of frost on water pipes, (7) corrosion of Cu, (8) effect of cast structure on rolling properties and (9) elimination of Bi in the smelting and refining of Cu. HBG (11a)

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An Improved Monel Metal Metal. *Metal Industry,* London, Vol. 46, June 7, 1935, pages 619-620. A description of "K" Monel. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 372L/2. HBG (11a)

Physical and Casting Properties of the Nickel Silvers. T. E. Kihlgren, N. B. Pilling & E. M. Wise. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 279-312. Includes discussion. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 333L/7. (11a)

Free Energy and Heat of Formation of the Intermetallic Compound CdSb. Harry Seltz & J. C. DeHaven. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 218-224. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 411L/9. (11a)

Properties of the Platinum Metals, I—Strength and Annealing Characteristics of Platinum, Palladium, and Several of Their Commercial Alloys. E. M. Wise & J. T. Eash. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 313-328. Includes discussion. See *Metals & Alloys,* Vol. 6, Mar. 1935, page MA 119R/6. (11a)

Determination of the Heats of Transformation of Cobalt (Untersuchungen über die Wärmetönung bei den Umwandlungen des Kobalts). H. v. Steinwehr & A. Schulze. *Zeitschrift für Metallkunde,* Vol. 27, Apr. 1935, pages 90-92. A calorimeter and method previously described (*Zeitschrift für Metallkunde,* Vol. 26, 1934, page 130) are used to measure the allotropic and magnetic heats of transformation of Co. The sample studied weighed 19.4 kg. and analyzed 98.1% Co, 1.6% Fe, 0.24% Cu, 0.007% C, and a trace of Ni. In 5 experiments the face centered cubic β to close packed hexagonal α transformation occurred at temperatures between 378 and 420° C., with an average heat evolution of 0.1 ± 0.03 cal./g. In 6 experiments the para- to ferro-magnetic transformation occurred at temperatures between 1070 and 1125° C. with an average heat evolution of 1.2 ± 0.07 cal./g. The bulk of the error is attributed to the temperature hysteresis of the transformation. GD (11a)

Notes on the Founding of Phosphor Bronze. R. C. Stockton. *Metal Industry,* London, Vol. 46, May 10, 1935, pages 503-505. The author points out that this is one of the alloys displaying a wide variation in physical properties with any alteration in casting procedure, particularly in the fluctuation of casting temperature. He believes that "cast-on" test bars may be made representative of the casting. Cited as governing factors which control production are (1) shape and size of the test bar, (2) position of the bars relative to the casting, (3) method of molding the bars, (4) nature of mold materials, (5) size of casting to which the bars are attached and casting temperature. These are discussed and in addition, phosphorus content and ductility, methods of introducing P to the charge. A bend test is suggested as an inexpensive method of approx. checking the bars to be used for official testing. The advantages of heat treating the bars, particularly those centrifugally cast, are indicated. The effect of heat treatment and different methods of casting on the hardness of phosphor bronze are compared for sand, chill and centrifugal castings. The greatest variation, due to heat treatment, was obtained on the chill cast and the least on the sand cast. HBG (11a)

11b. Ferrous

V. V. KENDALL, SECTION EDITOR

Effect of Uranium on Structure, Hardenability and Permanence of Temper of Carbon Steels (Einfluss des Urans auf die Gefügebeschaffenheit, Härtbarkeit und Anlassbeständigkeit von Kohlenstoffstählen) H. Bennek & C. G. Holzscheiter. *Technische Mitteilungen Krupp,* Vol. 3, Nov. 1935, pages 196-204. Literature on effect of U in steel is reviewed, but found incomplete. Two kinds of Fe-U were used in the experiments but only a Fe-U of low C and U which showed no segregations could be used for castings, and it had to be added to the well deoxidized melt in the ladle in small pieces. Fe-U of high C and U could not be used because of difficult solubility. The trial castings could be forged very satisfactorily up to 5% U. C steels with addition of U show 2 new components which are very likely U carbides. Hardening and tempering tests indicated a certain solubility of the γ-solid solution for U which is, however, of rather limited practical use as fusion occurs at fairly low temperatures. Hardening is somewhat improved by U and the overheating sensitivity somewhat reduced. U acts like Cr as a special carbide forming element. The improvement of the mechanical properties by U is low; tables show the results in detail. Ha (11b)

Influence of Phosphorus on the Temper Brittleness (Einfluss des Phosphors auf die Anlasssprödigkeit) H. Bennek. *Technische Mitteilungen Krupp,* Vol. 3, Nov. 1935, pages 205-213. While additions of 0.03-0.1% P to C steel do not cause temper brittleness they do when added to Mn, Ni, Cr, Cr-Ni and Cr-Ni-Mo steels. Additions of 1.5% Mn, Ni or Cr to C steel of very low P content cause very slight if any, temper brittleness. The improvement in temper brittleness by tempering of long duration at 650° C. is connected with an equalization of the P segregations by diffusions. The same effects can be obtained by diffusion annealing before hardening; the improvement is, therefore, not reversible. The precipitation hardening by phosphide is made stronger by Mn, Ni and Cr. The experiments make it appear very likely that the phosphide precipitation in the crystal segregations is one of the reasons for the temper brittleness of commercial steels. Test results in tables and curves show the progress in brittleness and notch-toughness with different P contents. 13 references. Ha (11b)

Chromium Steels of High Nitrogen Content. Russell Franks. *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 968-994. Discussion. Data are presented showing N effects marked grain refinement in Cr steels. A Cr nitride is formed which acts similar to carbide as a hardener and acts as a grain growth inhibitor. This nitride is soluble in austenite and hardens the steel while imparting a toughness not associated with carbide hardening of steel. WLC (11b)

Magnetic Alloys of Iron, Nickel and Cobalt. G. W. Elmen. *Electrical Engineering,* Vol. 54, Dec. 1935, pages 1292-1299. Designations and compositions of some magnetic alloys on an Fe-Ni basis with additions of Co, Cr, Mo and V are given, magnetic properties and heat treatment described. A table shows some remarkable results obtained in laboratory specimens; a permalloy of 65% Ni and 35% Fe had a max. permeability of 610,000, another with 78.5% Ni and 21.5% Fe, 41,000. Some engineering applications (especially in telegraph and telephone cables) are discussed. 7 references. Ha (11b)

Simple Stepping Stones to the Alloys. *Industry & Welding Quarterly,* Dec. 1935, pages 170-175. A few brief historical remarks on the development of alloy steels and the qualities and uses of Ni, Si, V, Cr-Ni, Si-Mn, Cr-V, Cr-Mn-Si, Mn and Mo steels. Ha (11b)

Steel Manufactured in France (Les Aciers de Fabrication Francaise) *Métaux et Machines,* Vol. 19, Oct. 1935, pages 353-360; Nov. 1935, pages 389-392. Discusses stainless steels and deals with the following points: Heat resisting steels: composition, physical properties, heat treatment, mechanical properties at room and high temperatures, corrosion resistance, machinability, applications. FR (11b)

Phosphorus as an Alloying Element in Steel. A Correlated abstract. H. W. Gillett. *Metals & Alloys,* Vol. 6, Oct. 1935, pages 280-283; Nov. 1935, pages 307-310. 43 references. Summarizes data on the effect of P on steel indicating it may have very useful as well as harmful effects. It is particularly effective in increasing machinability, strength and corrosion resistance of low C steel. Its value is exclusively in low C steel. The effect of residual P probably differs from P added in making the steel. WLC (11b)

The Effect of Copper in Gray and Malleable Iron. A. J. N. Smith. *Foundry Trade Journal,* Vol. 52, June 13, 1935, page 402. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 508R/3. AIK (11b)

The Specifications of Magnetic Qualities. L. G. A. Sims. *Engineering,* Vol. 140, Sept. 13, 1935, pages 290-291. From a paper read before Section G of the British Association for the Advancement of Science, Sept. 9, 1935. LFM (11b)

Hardening Cast Iron with Alloy Additions. J. S. Vanick. *Metal Progress,* Vol. 28, Dec. 1935, pages 42-47, 80. Starting with a base metal balanced to give graphite in a pearlitic matrix without ferrite, data are given to produce any hardness up to 750 Brinell with alloy additions appropriate to various sectional thickness. WLC (11b)

Interpretation of Torsion Impact Properties of Carbon Steel. G. V. Luerssen & O. V. Greene. *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 861-885. 11 references. Discussion. The characteristic shape of torsion-impact value vs draw temperature curves for C tool steel is discussed. The first maximum occurs with relief of strains in martensite followed by drop and minimum when all retained austenite is decomposed with accompanying drop in hardness and ductility of such magnitude as to account for decreased torsion-impact strength. This minimum is followed by a rise during which softening of the martensite occurs with increased ductility. WLC (11b)

Influence of Cold Deformation and Annealing on the Properties of Chromium-Molybdenum Steel Tubing. Z. N. Rafalovitch. *Domez,* No. 7, 1935, pages 32-56. In Russian. Tubes having an average composition 0.34% C, 0.7% Mn, 0.82% Cr, 0.20% Mo were drawn in an Amsler machine through dies with and without mandrel after being annealed at 860° C. and furnace cooled. Deformation was adjusted either to vary 10-11% from pass to pass or the total deformation was given in a single pass. In tubing drawn without a mandrel radial deformation is greater than longitudinal starting from a certain degree of deformation which results in the changes in microstructure and increased thickness of the walls. When a mandrel is used, the grains are elongated only longitudinally. When the tubes were deformed in a single pass no difference in structure could be observed. The type of deformation does not have any effect on the mechanical properties of the metal. Energy consumed for deformation is greater in gradual deformation than in the deformation in a single pass because in the former elastic deformation has to be overcome repeatedly. In deformation on a mandrel the energy required stabilizes but gradually, corresponding to the change in the orientation of the grain. With all grain oriented longitudinally the energy consumption drops. The efforts present in mandrel drawing are always higher than when it is omitted. The efficiency is better when no mandrel is used and it increases with the rising percentage of deformation. On annealing after cold drawing the restoration of the original mechanical properties is more complete the greater was the deformation, and the deformed metal might have better properties after annealing than the original. Optimum temperature for restoration of properties was 750° C. A maximum grain growth takes place at a deformation of about 10-15% as in common low C steels. The cold drawing orientation of the grain totally disappears at 750° C. and coarse crystallization starts at 800° C. A maximum ductility of tubing cold deformed beyond 30% is produced by annealing at 750° C. at which the original lamellar pearlite is transformed into granular. Annealing time between 30 minutes and 3 hours produces identical results. To effect the desired results any annealing must be preceded by a proper reduction. Reduction of 10 and 20% followed by any annealing temperature tried did not make the tubes suitable for further direct reduction of 70%. Starting with a 28% reduction annealing at 750° C. is sufficient to permit further reduction without any intermediate annealing until the original size is reduced 70%. The same effect can be occasionally produced by 700 and 800° C. annealing, but 750° C. is preferable. The paper is fully illustrated by numerous diagrams, tables and photomicrographs. (11b)

Special Steels. R. Hadfield. *Iron & Coal Trades Review,* Vol. 131, Nov. 8, 1935, page 761. Paper read before the International Congress of Mining & Metallurgy in Paris. It deals quite generally with the achievements of French metallurgists, the rapid progress of alloy steels, coöperation in scientific metallurgy, and reviews the economical advantages, chemical and physical properties of alloy steels of various bases, and the fields of application. Ha (11b)

The Production and Utilization of Virgin Irons Containing Titanium and Vanadium. Jean Challonsonnet. *Foundry Trade Journal,* Vol. 53, Sept. 26, 1935, page 231. Abstract of a paper presented to the International Foundry Congress in Brussels. The author has dealt with the irons available to commerce which, naturally, contain varying quantities of Ni, Cr, Ti and V, the best known of these being the Mayari brand of Fe. He stresses both the thermal stability of pearlitic irons containing V and their anti-growth properties. He recommends the use of V for the manufacture of ingot molds. The modulus of elasticity, the author states, is the surest criterion of the mechanical quality of foundry irons, and this modulus depends, to a large extent, on the form of the free graphite. AIK (11b)

Cold-Worked High-Strength Bars Tested for Concrete Reinforcing. *Engineering News-Record,* Vol. 115, Oct. 10, 1935, page 506. Isteg steel reinforcement consists of 2 plain round bars twisted together cold. Since the bars are also stretched the steel is cold-worked in both tension and torsion with an increase in both yield point and ultimate strength. Tests made at Columbia Univ. show that increases in design stresses may be permitted. CBJ (11b)

Stainless in Compression. W. L. Sutton. *Aviation,* Vol. 34, July 1935, pages 29-31. Based on actual tests, a critical comparison is made between stainless steel and Al alloys in compression. It is proved that stainless steel carries a much higher ratio of unit stress in the short column range. It is definitely better than the Al alloy, considering similar size tubes, for all-around usage as column. If a given compressive load is to be carried by a tube and the size is not restricted, however, Al alloy has a definite advantage over an ordinary steel tube. Considering standard size tubes of equal weight, the Al alloy tube has a larger diameter than the steel tube, and, hence, a smaller slenderness ratio. Tests have been run on thin-wall stainless steel tubes under direct compression. A stainless steel built-up pin-ended tube, carries slightly more load than the Al alloy tube. Where design conditions limit the overall size of members, stainless steel standard size tubes can be used to great advantage. A comparison between 24ST Al alloy and stainless steel corrugated sheet, when tested in compression with flat ends, showed a decided advantage in favor of stainless steel. If protective coatings were to be carried for the Al alloys the advantage becomes still greater. As the normal working range of slenderness ratio is around 50, weight savings of 10-15% are possible. The close permissible pitch of the shot welds fastening the flat skin to the corrugation enables the maximum amount of flat skin to work with the corrugation. Diagrams show the Johnson-Euler curves for 18-8 and 24ST. EF (11b)

Notes on Roll Failures with Reference to Chilled Iron Cast Rolls Containing Chromium and Molybdenum. J. Selwyn Caswell. *Foundry Trade Journal,* Vol. 53, Nov. 14, 1935, pages 369-371; *Iron & Coal Trades Review,* Vol. 131, Nov. 22, 1935, pages 859-861. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 508L/9. AIK + Ha (11b)

A New Heat Resistant Alloy. S. L. Hoyt & M. A. Scheil. *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 1022-1046. Discussion. These data previously abstracted from article by one author in *Metal Progress,* Vol. 28, June 1935, pages 38-40. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 508. WLC (11b)

Molybdenum-Tungsten High Speed Steel. Robert S. Rose. Frank Garratt. *Metal Progress,* Vol. 28, Sept. 1935, pages 65-66. Discussion of **New High Speed Steel Molybdenum with Tungsten.** Frank Garratt. *Metal Progress,* Vol. 27, June 1935, pages 38-43. Includes reply of Garratt to objection by Rose to the ~~temperature~~ of treatment used ~~on~~ 18-4-1 steels of the original article. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 508. WLC (11b)

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Relation of Rolling and Recrystallization Textures of Iron-Nickel Alloys to Their Magnetic Properties (Walz- und Rekristallisationstexturen bei Eisen-Nickellegierungen im Zusammenhang mit den magnetischen Eigenschaften). Fr. Pawlek. *Zeitschrift für Metallkunde,* Vol. 27, July 1935, pages 160-165. Reversible Fe-Ni alloys were prepared by melting Swedish Fe with Mond Ni and by sintering carbonyl Fe and Ni, but no marked differences of behavior were found. All data are for a 40% Ni, 60% Fe specimen in the rolling direction. For 50%, 80%, and 98.5% reductions the normal combination of orientations was found with a [112] direction and a (110) plane in the direction and plane of rolling, respectively, or a [111] direction and a (112) plane. With reductions of less than 90% the recrystallization structure was random; above this a texture appeared and became completely [100] in the rolling direction with (010) in the plane of rolling when annealed above 800°. Between this temperature and that of recrystallization, 500°, another undetermined orientation was evident. Curves are shown for the magnetic and tensile properties after the above reductions and for annealing temperatures between 20° and 1100°, all of which show sharp breaks corresponding to the recrystallization temperatures, with additional differences dependent upon whether or not the recrystallized material is randomly oriented. Annealing above 1100° produced exceptional grain growth and a distinctly new preferred orientation with a [100] direction in the rolling direction and a (120) plane in the surface. Subsequent cold rolling of recrystallized material with the cubic texture produced no change in this orientation with less than 80% reduction, though transition to the normal texture is complete with 90% reduction. Reannealing this originally cubic material produces no texture for reductions of less than 90%. Corresponding anomalies are found in the magnetic and tensile properties. Reduction of 50% produces the lowest residual magnetism and special curves are shown for initial material of both the random and cubic types of orientation, the latter having a higher recrystallization temperature extending over a wider range, accompanied by anomalies in the recovery curves for the other properties. GD (11b)

Addition of Steel Scrap to Melts for Chilled Castings (Ueber Stahlschrottzusatz bei Hartgussschmelzen) Hugo Patsch. *Giesserei,* Vol. 22, Nov. 22, 1935, pages 584-586. More recent investigations seem to point to the incorrectness of the rule that depth of hardness of chilled castings depends on the Si content. Besides the Si, the graphite remaining in the melt is of considerable influence on the formation of the zone of hardness. The addition of steel scrap not only improves the mechanical properties of the casting but also the depth of hardness. Ha (11b)

Recent Experiences in the Use of Cast Iron as Designing Material (Neue Erkenntnisse in der Verwendung von Gusseisen als Konstruktionsmaterial) A. Thum. *Giesserei,* Vol. 22, Oct. 25, 1935, pages 529-533. The wider use of cast Fe in recent years is based on the more perfect knowledge of the influence of shape on tensile strength and mechanical properties and of the accuracy with which a cast Fe of definite quality can be obtained by correct composition. It is a serious competitor of steel and light metals which, from the German standpoint, is important as no imported raw materials are required for its production. Practical possibilities and comparisons with American practice are described. Ha (11b)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Transition from Brittleness to Plasticity in Crystals with Increasing Temperature (Der Übergang von der Sprödigkeit zur Verformbarkeit bei Kristallen mit steigender Temperatur). G. Tammann & W. Müller. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 224, Sept. 13, 1935, pages 194-212. Rupture in crystals occurs either on crystallographically defined planes or on regularly disposed surfaces of the crystal as in glass. The planes of rupture are the places of cohesion minima. With increasing temperature the brittleness vanishes. The ranges of brittleness and gliding are not clear cut ranges, but one or the other merely becomes the predominant phenomenon below or above a certain temperature interval. The ranges may occur simultaneously. The gliding of crystal particles is differentiated from the sliding of 2 flat plates on one another in that (1) on the gliding planes the gliding can take place, as a rule, only in one direction, (2) with gliding in effect the friction on the gliding plane increases, (3) with increasing pressure at right angles to the gliding plane the gliding friction decreases, but for 2 plates on one another the friction increases, (4) in rubbing 2 plates on one another the energy used goes entirely into production of heat, but in friction of 2 crystal surfaces a portion of the work done remains in the crystal as potential energy and gives rise to production of heat only by increasing the temperature in a range for which the other properties changed by the gliding reassert themselves. The changes taking place in the gliding of crystal planes which are favorable to deformation are discussed and experiments with various crystalline salts are described involving the use of scratch figures at room temperature and increasing temperatures up to 350° C. The changes in the scratch figures as the temperature is increased show the change from brittle material to material of greater deformability. Pressure figures were also produced on the crystals with a sewing needle and length of the axes measured at room temperature with crossed Nicols. The materials were then heated at various temperatures up to 400° C. for 5 and 30 minutes, and the length of axes again measured. The temperature at which the figure again disappears is obtained and related to the deformability of the material; this is considered analogous to the decrease in resistance of a drawn rod of metal by heating for complete recovery of original resistance before cold-working. The pressure and scratch figures of the various materials at different temperatures are shown, and hammer figures on glass and quartz (appearance of fractures obtained by impact of hammer) are discussed and shown. WB (12)

Effect of High Temperatures on the Strength of Soft and Medium Carbon Steels Under Static and Dynamic Stressing (Der Einfluss hoher Temperaturen auf die Festigkeitseigenschaften von weichen und mittelharten Kohlenstoffstählen bei statischer und dynamischer Beanspruchung). K. Uhlemann. *Metallwirtschaft,* Vol. 14, Sept. 27, 1935, pages 773-778; Oct. 4, 1935, pages 795-798. Static tensile tests, impact tests, and endurance tests with smooth and notched test bars, were made at 20°, 200°, 300°, 400°, and 500° C. on 5 steels. A was a .12 C steel, B .50 C normalized, C .50 C heat treated, D .60 C air quenched and drawn, E .70 C, .27 Ni, .06 Cr, .12 W heat treated. All the steels showed the characteristic blue brittleness at 200°-300°, as evidenced by increased tensile strength and lowered elongation and reduction in area. The yield point did not increase in this range. The endurance limit increased similarly, but reached its maximum at higher temperatures. For steel B the maximum was between 400° and 500°, for the others between 300° and 400°. At 500° the endurance limit was lower than at 20°, with the exception of steel B. For steels A to D the increase in tensile strength was up to 25%, the increase in endurance limit slightly higher, from 18 to 27%. With steel E the increase in tensile strength above room temperature was slight, the endurance limit dropped 7% and then rose slightly but did not regain its 20° value. The impact strength dropped at 400°-500°. No relation was found between impact and endurance properties. The surface oxidation which occurred at 400° and 500° did not lower the endurance limit in the same manner as salt water corrosion. The notched bars for endurance tests had a 45° notch, 3.5 mm. deep. The ratio of notched to smooth endurance limit at 20° was close to .5 and did not change much at elevated temperatures. It was slightly higher for steel A than the others, and for steel C dropped to .36 at 500°. Some tests were also made with a .25 mm. deep notch. The ratio was higher and varied more with C content, .8 for A, .66 for B, .62 for D, and .56 for E. Complete data are given in tabulations and in graphs. 13 references. CEM (12)

Scaling of Iron and Other Metals (Über die Verzunderung des Eisens und anderer Metalle). Kurt Fischbeck & Franz Salzer. *Metallwirtschaft,* Vol. 14, Sept. 13, 1935, pages 733-739; Sept. 20, 1935, pages 753-758. The work of other authors on the scaling and oxidation of Fe, given in 42 references, is reviewed at some length. Scale formed above 570° C. on Fe consists of several layers. Next to the Fe is "oxoferrite," which is Fe with O in solid solution, then follow FeO, Fe_3O_4 and Fe_2O_3. At lower temperatures FeO breaks up into oxoferrite and Fe_3O_4. The composition and thickness of the different layers and the speed with which they form depend on the composition of the gas in contact with the metal, its pressure and velocity, and on the temperature and the resistance to reaction and diffusion. Equations giving the relation of these factors under various conditions are developed. The rate of scaling of Fe increases until the A_3 transformation point is reached, where a sudden drop occurs, after which the rate increases again. Scaling of Fe can be reduced by the addition of 10% Al, 15% Cr or Al and Cr. The authors themselves investigated the oxidation of pure Fe wire in CO_2, H_2O, NO, SO_2 and O_2 and of Mn in lump form in O_2 at various temperatures. The increase in weight is plotted against time and the initial reaction velocity against temperature. The latter curves for Fe have a sharp break at the A_3 point in the case of each gas except SO_2. The oxidation in SO_2 was so rapid that it was not carried above 850°. The curve for Mn has a much smaller break at the transformation point than the Fe curves. The scale from a heavily oxidized Fe wire was removed by filing off thin layers and each layer was analyzed for Fe content and some examined by X-rays. About 95% of the scale consisted of FeO, the balance of the higher oxides. CEM (12)

Types of Cast Iron for Use at Elevated Temperatures (Fontes destinées aux Application à chaud). Lemoine. *Usine,* Vol. 44, Oct. 31, 1935, page 27. Results of recent investigations of heat-resistant cast iron are summarized. Growth of cast Fe under repeated heating has 3 causes. Due to the low density of the graphite liberated by the heating the cast Fe expands irreversibly so that after cooling, the piece has larger dimensions than before. The outer layers begin to graphitize under heating before the heat has penetrated into the interior so that cracks are developed which also contribute to a growth in volume. Into these cracks, gases of a more or less corroding nature can enter thus forming Fe compounds, a third cause of increase of volume. Remedies are to use a cast Fe which remains pearlitic up to temperatures of 600°-650° C., or for temperatures up to 800°-900° C., a cast Fe (for which the pearlitic structure is not indispensable), modified by adding 1-2% Cr or by diminishing the C content to 2.2-2.5%. The properties of such types of cast Fe are described. Ha (12)

Creep of Flanges (Das Kriechen von Flanschverbindungen). Kurt Adloff. *Die Wärme,* Vol. 58, June 15, 1935, pages 387-389. Stress distribution in relation to physical properties of structural materials. Discussion on interrelations between flange and bolt material of different creep resistance. EF (12)

Experience with Welded Joints for High Pressure and Temperature Steam Pipework. A. G. Bugden. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 187-197. Tests showed that flanges can be welded safely to pipe and the flanges then joined by welding without the use of bolts or nuts. Actual experience has proved that the joint is satisfactory for high steam pressure and temperature. See also *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 511R/10. JLG (12)

Impact Resistance of Certain Nickel Steels at Low Atmospheric Temperatures. D. A. Campbell. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 761-781. Steels investigated were S.A.E. 1010, 1035, 1070, 2110, 2175, 2230, 2320, 2330, and 2375. For these steels with a quench and draw treatment the low temperature impact values show an increase over room temperature values and the fully drawn (1150° F.) specimens show the highest resistance at all temperatures. Small quantities of Ni improve low temperature impact values when the proportions of Ni are not sufficient to destroy the polyhedral grain structure and give acicular grains. Fractured surfaces can be used as a definite indication of relative impact values. WLC (12)

The Testing of Materials at High Temperatures. H. J. Gough & W. J. Clenshaw. *Mechanical World & Engineering Record,* Vol. 48, Oct. 11, 1935, pages 349-350. The work and apparatus of the National Physical Laboratory are described and a summary of the present state of knowledge on the subject is given. WH (12)

The Embrittlement of Steels Due to Soaking at High Temperatures. D. A. N. Sandifer. *Engineering,* Vol. 140, July 26, 1935, pages 81-82. Izod tests were made on 4 steels to determine which types are most satisfactory for use as turbine bolts and studs. The 4 steels, (1) Durehete, (2) Tormanc Major, (3) Tormanc and (4) Tormol have the following percentage composition, respectively: (1) C 0.5, Mn 0.6, Si 0.237, S 0.035, P 0.037, Ni 0.08, Cr 1.16, Mo 0.59; (2) C 0.31, Mn 1.3, Si 0.165, S 0.033, P 0.035, Mo 0.2; (3) C 0.33, Mn 1.34, Si 0.171, S 0.034, P 0.034; (4) C 0.32, Mn 0.56, Si 0.239, S 0.036, P 0.031, Ni 2.64, Cr 0.71, Mo 0.49. The steels were oil-hardened at 850° C., 840° C., 830° C. and 830° C., respectively. The test specimens were of the 3-notch British standard Izod form, 13 cm. long. The notches were not cut until after hardening, tempering and soaking were completed to avoid distortion of the notches. The first group of tests was on the 4 steels oil-tempered at 575° C. and the second group on the steels tempered at 600° C. To simulate turbine conditions the test pieces were placed in a cold furnace which was quickly brought to 450° C. and kept there for a varying number of days. Graphs are given showing the results of these tests. It was found that a tendency to embrittlement was either not present at all or else it was very marked. If present, embrittlement took place rapidly reaching its maximum in 4 or 5 days. If embrittlement did not occur there was a slight fluctuation in the Izod value during the first 4 days but the value remained constant after that. All the steels containing Mo were unaffected in their Izod values for the tempering temperatures used. Tormanc, containing no Mo, suffered serious embrittlement for both tempering temperatures. The results show that a small percentage of Mo counteracts the embrittling effect that more than 1% of Mn produces. LFM (12)

Influence of Carbon Content on High Temperature Properties of Steels. A. E. White, C. L. Clark & R. L. Wilson. *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 995-1021. 4 references. Discussion. Reports a study of short time tensile, creep and impact characteristics of S.A.E. 1010 and 1045 and two Si-Cr-Mo steels of 0.075 and 0.48% C, respectively, and with approx. 0.70% Si, 1.25% Cr and 0.50% Mo in each, at temperatures 85°-1400° F. Results indicate that at elevated temperatures the behavior of these steels is sometimes independent of C content and may be affected by previous treatment and by the presence of an alloy which affects the character of the carbides. Lamellar arrangement of carbide with increased C increases the creep strength. Tests at some temperatures (1200° F. for 1045) show spheroidization and loss of creep strength. Lower C steels possess higher impact strength at both room and high temperatures. A minimum occurs at 900°-1100° F. which may tend to rise with C content. C content appears to have little influence on the structural stability at elevated temperatures. Metallographic examination and room temperature tests after heating show that 800° and 1000° F. are without effect while treatment at 1200° F. results in spheroidization with loss of tensile strength and increase in impact and ductility values. WLC (12)

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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

The Wear of Steel Rails. A. McCance. *Railway Gazette,* Vol. 63, July 12, 1935, page 56. Friction and pressure are chiefly responsible for rail wear. Rail steel is elastically deformed by the pressure of the rolling stock and the repetition of this stress is supposed to result in fatigue. Thus minute pieces of steel become detached or flattened out by the rolling action and cause a loss of weight or wear. With an increase of load or reduction in wheel diameter, wear rapidly increases. Steels with highest fatigue limit resist wear best (0.1% C, 1.5% Cr steels). Recommends the use of the Amsler machine in which 2 discs of the material are rotated, one at a speed 10% greater than the other and pressed together by a force which can be varied. The author recommends a 1.0-1.3% Mn steel with the view of producing a homogeneous structure with a larger portion of pearlite. Slowly cooled rails may be expected to wear more rapidly than quickly cooled rails. The greatly reduced life of steel in tunnels is attributed to condensation of moisture and subsequent corrosion fatigue. A steel containing 0.25% C, 0.25% Si, 0.68% Mn and 2.89% Cr is recommended for rails in tunnels. Its breaking strength is 79.6 tons/in.^{2} with 14% elongation per 2″ and 32% reduction of area. The Brinell hardness is 370 kg./mm.^{2} Oxide films have a marked effect upon the wear due to sliding. A steel which will form a film rapidly should wear well and the composition of good wearing steels in the future may be very different from those of today. This may account for the good wearing qualities of an otherwise extraordinary German rail composition containing 0.1% C, 0.4% Si, 1.3% Mn, 0.18% P which though having a breaking strength of only 37.5 tons/in.^{2} with 20% elongation and 55% contraction has worn only 70-80% that of normal rail steel. WH (13)

Effect of Special Additions on Scaling of Steel (Ueber den Einfluss von Sonderzusätzen auf das Zundern des Stahls). K. Kiwit. *Mitteilungen der Kohle- und Eisenforschung G.m.b.H.,* Vol. 1, No. 2, July 1935, pages 9-28. The scaling of steels at temperatures of 900°, 1000°, 1100° and 1200° C. was investigated with particular consideration of the behavior of the additions. The formation of scale by diffusion created sharply defined layers of scale which were analyzed individually. All alloying elements of steel, base as well as noble elements accumulate at the border of the iron scale. The elements Al, Cr and Si, which increase the resistance to scaling noticeably, and Ti, Be and V, which increase it only slightly, form protective layers. The addition of a nobler element, Cu, Ni and Pt, did not give an improvement in scaling resistance, Pt was even detrimental. The investigation led to the conclusion that in order to obtain a protection against scaling, the new kind of crystal which is formed by the diffusion of the Fe atom but not by that of the O atoms, must possess a low diffusion velocity and be soluble in ferrous oxide, and besides must form a tight envelope around the Fe which also prevents the diffusion of Fe. The composition of scale layers is shown in photographs, the tests and their results discussed in detail. 26 references. Ha (13)

Attack of Hydrogen Sulphide on Boiler Walls (Angriff von Schwefelwasserstoff auf die Kesselwandungen). N. Christmann. *Die Wärme,* Vol. 58, Aug. 17, 1935, page 534. Investigations on defective boiler members revealed a novel kind of corrosion defect which seemed to be connected with boiler incrustations. It was established that Ca and Na-sulphate are reduced to sulphides by H_2 liberated by steam dissociation at elevated temperatures. The sulphides are said to corrode the boiler walls. Ferritic Cr-Al steels showed great resistance to this kind of attack. A Ni content up to 7% was not affected by S and its compounds up to 650° C. At higher temperatures a Ni content is detrimental due to the formation of a low melting Ni-S eutectic. Al has a beneficial effect regarding the resistance towards gases containing S. With rising temperatures, higher Al contents are mandatory. EF (13)

Pitting of Stainless Steel by Leather. J. N. Smith. *Product Engineering,* Vol. 6, Dec. 1935, page 465. It was observed that stainless steel shafts stored in a humid atmosphere with leather flange packings showed pitting at the point of contact with the leather. The action was found to be electrolytic rather than chemical; the leather absorbed moisture which reacted with the salts in the leather, the steel being removed and deposited in the leather. A filler (composition not given) was found which inhibited the corrosion. Ha (13)

Corrosion of Welds in Aluminum Cables (Sulla corrosione delle saldature di cavi in alluminio). II. O. Scarpa. *Alluminio,* Vol. 4, July-Aug. 1935, page 218. Samples kept in 2% NaCl solution for one year show a loss of 1.15% by corrosion, or about twice as much as shown in 4 months. AWC (13)

Problem of Embrittlement of Boiler Plate (Zur Frage der Sprödigkeit von Kesselblechen). *Die Wärme,* Vol. 58, Sept. 7, 1935, pages 579, 585. Refers to statements made by E. P. Partridge, *Mechanical Engineering,* Vol. 57, May 1935, page 294. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 339L/1. EF (13)

Joint Report on Fissured Rails. *Railway Engineering & Maintenance,* Vol. 31, Oct. 1935, page 578. Summarizes progress reported by H. F. Moore in charge of the test party of the Joint Rail Investigations of Fissures in Railroad Rails of the A.R.E.A. Rails that had been given special thermal treatment before or during the cooling treatment showed almost complete absence of shatter cracks and internal fissure development before 1,000,000 repetitions of a rolling wheel load of 75,000 lbs. Fissures, a result of fatigue, usually originate at shatter cracks which are due to internal stresses set up during cooling in the mill. WH (13)

The Influence of Oxide Films on the Wear of Steels. Samuel J. Rosenberg & Louis Jordan. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 577-613. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 540. WLC (13)

Study on the Passivity of Iron and Steel in Nitric Acid Solution. Report VII. Yôichi Yamamoto. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 14. Oct. 1935, pages 925-964. In Japanese. *Scientific Papers & Abstracts Institute of Physical & Chemical Research, Tokyo,* Vol. 28, Oct. 1935, page 60. In English. Continuing previous research (See *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 281 L-10; Vol. 5, Oct. 1934, page MA 367 L-3; Nov. 1934, page MA 462 R-1; R-2; Vol. 6, Feb. 1935, page MA 75 L-7; Mar. 1935, page MA 123 R-4; Apr. 1935, page MA 167 L-9; Oct. 1935, page MA 417 R-1, R-2) a study was made of the influence of internal stresses in Fe wire produced by twisting on the appearance of the passivity of a stressed Fe wire in concentrated HNO_3. It was established that passivity became more difficult the greater the internal stresses. WH (13)

Ocean Transportation of Petroleum in Bulk. Robert F. Hand. *Transactions North-east Coast Institution of Engineers & Shipbuilders,* Vol. 51, 1934-35, pages 323-346. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 415R/9. WB (13)

Theory of Passivity Phenomena. XXVIII. The Anodic Behavior of Iron in Sodium Chloride and Hydrochloric Acid Solutions (Zur Theorie der Passivitätserscheinungen. XXVIII. Ueber das anodische Verhalten von Eisen in Natriumchlorid- und Salzsäurelösungen). J. Müller & W. Machu. *Zeitschrift für Elektrochemie,* Vol. 41, Sept. 1935, pages 641-653. Using the method of protected electrodes which measures the current passing between two specimens held at constant potential the behavior of Fe in several chloride solutions has been determined. A passive film has been found on Fe surfaces in NaCl solutions. varying in concentration from saturated to 0.1 *N* and in HCl solutions varying in concentration from 0.26-6.68 *N*. For freshly ground surfaces there appear in such solutions numerous current fluctuations that are not found in sulphate solutions. A final current is reached which in all cases is much higher than for the same voltage in sulphate solutions. It was found that the passive layer consisted of small doubly refracting crystals which had a very short life time. In 6.68 *N* HCl the life time is about 3 min. In dilute acids and NaCl solutions the life time varies inversely with pH and amounts to a few sec. in a neutral NaCl solution. This surface film is evidently a basic salt that does not polarize. It is not possible to activate such surfaces with a Zn wire. They may be activated by brushing off with a small hair brush. Current-time curves of such active surfaces are analogous to those obtained in sulphate solutions. Very short passivating periods are found for solutions of less than 0.5 *N*. The passivating period increases with concentration to 1*N*, and thereafter decreases with rising concentration. In a solution of saturated $Fe\ Cl_2\ .\ 4\ H_2O$ in 1 *N* HCl the passivation period was considerably longer than in solutions containing only Na_2SO_4. Chemical passivation is characterized by Fe going into solution as Fe^{+++}. Such passivation was never completely realized. A saturated NaCl solution at 0° C. and a current density of 8 amps./cm.^{2} produced a passivity where 55% of the Fe went into solution as Fe^{+++}. Low temperatures and low current densities favor such films. All of the observed phenomena may be explained by the assumption that the film formed in chloride solutions is more porous than that formed in sulphate solutions. In general, the anodic behavior of Fe in NaCl and HCl solutions is in complete accord with the theory of protective passivity. HAS (13)

Studies on the Oxidation of Metals. Part II. Copper, Brass, Aluminum-Brass, Aluminium-Bronze, Magnesium, and Some Magnesium Alloys. G. D. Preston & L. L. Bircumshaw. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Oct. 1935, pages 706-720. The nature of an oxide film formed on a metal at low temperature was investigated. The results of the experiments are summarized as follows: The oxide film formed at room temperature on Cu and 100° C. in air and at 183° C. in O at atm. pressure consists of Cu_2O with the usual cubic structure of this oxide. No definite indication of the presence of CuO could be found. The oxide is oriented with a (111) plane parallel to the polished surface of the metal. A brass containing 70% Cu, 30% Zn, which was oxidized at temperatures up to 183° C., is covered with a film of Cu_2O. At 400° C., the oxide film is ZnO. Al brasses (22% Zn, 2% Al) show Cu_2O after oxidation at 183° C. for 10 min. At 400° C., ZnO is present with another, unidentified phase. The oxide film formed at room temperature did not permit of an interpretation as the photograph was not clear enough. The absence of any trace of Al_2O_3 is ascribed to the amorphous nature of this film. Mg and Mg alloys always showed a film of cubic MgO at 400° C. At lower temperatures interpretation was difficult, but the presence of MgO is probable. The films of oxide on polished surfaces are generally oriented. The nature of the orientation seems to be so that the plane in the oxide having the highest density of metal atoms per unit area tends to lie on the polished surface. 12 references. Ha (13)

Corrosion Control with Marble Filter. Henry Ryon. *Water Works & Sewerage,* Vol. 82, Oct. 1935, pages 360-361. The corrosion of the pipes (iron and brass) in a water distributing system was successfully stopped by passing the water which had a very high CO_2 content and low pH, through a filter of crushed marble. The original CO_2 content of 26 p.p.m. was reduced after 90 min. contact of the water with the filter to about 7 p.p.m. while the O content in the filtered water rose from 1 to 3.6 p.p.m. in the same time. Ha (13)

Huey Test for Corrosion Resistance. John L. Miller. *Metal Progress,* Vol. 28, Dec. 1935, page 54-55. Reports the results of tests as to the reproducibility of Huey corrosion test. Results show that at least 70 cc. of conc. HNO_3 should be used per in.^{2} of exposed specimen surface, concentration should be 67% or higher at the start, the 48 hr. period of test should not be exceeded and slight variations in impurity content of acid should be watched. See also "Factors Influencing the Nitric Acid Test for Stainless Steels," *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 374R/2. WLC (13)

Testing of Seawater-Resistant Aluminum Alloys in the North Sea (Prüfung seewasserbeständiger Aluminium-Legierungen in der Nordsee). H. Röhrig & W. Nicolini. *Aluminium,* Vol. 17, Oct. 1935, pages 519-529. Smooth, riveted and welded samples of pure Al, 99.7%, albondur, pantal, hydronalium, and KS- and BS-seawater Al alloys were exposed to the tides in the North Sea for 1½ years. Surface quality, tensile and shear strength and elongation were tested; the results are shown in detail in tables and photographs. The BS and KS alloys and hydronalium, both hard and soft, withstood perfectly the effects of the exposure for 1½ years. The welded samples of pure Al (hard as rolled), pantal and hydronalium also did not change their properties. The riveted samples suffered very little, the shearing strength remained the same in all uncorroded samples. Hard pure Al showed loss of strength and elongation. Ha (13)

Effects of Various Elements on the Corrosion Resistance of Mild Steels. Takejirô Murakami, Hikozô Endô & Harujirô Sekiguchi. *Kinzoku no Kenkyu,* Vol. 12, Sept. 20, 1935, pages 430-448; Oct. 20, 1935, pages 459-477; Nov. 20, 1935, pages 522-536. In Japanese. With the object of studying constructional steels having considerable corrosion resistance, a series of corrosion tests by dip method were carried out with steel specimens containing one or more alloying elements prepared by rolling and annealing of the cast ingot. As the corrosive media aqueous solutions each containing a different salt or acid were used. The effect of Cu on the corrodibility of low C steel was at first studied, and it was concluded that certain Cu bearing steels have excellent resistance to corrosion in acidic solutions which have no oxidizing property. Under the same conditions of annealing the best effect was obtained on the specimen containing 0.35% Cu, which corresponds to the solubility limit of Cu in α-Fe. For the effect of Cu atom dissolved in α-Fe on its corrodibility in acidic solutions, an explanation in detail is given. The effects of Al, Cr, Si, Mn, W, Ni, Mo, Co and Ti on the corrodibility of a low C steel containing 0.35% Cu was next studied. It was also found that the addition of 2% Al increases the corrosion resistance of the Cu bearing steel in solutions of salts and acids, Cr increases its corrosion resistance in various solutions, and about 2% Si increases its resistance in acidic solutions which have no oxidizing property, but Mn decreases the resistance. The respective addition of a small quantity of W, Ni, Mo or Co to the steel gives no favorable effect against corrosion. Addition of both Ti and Si also gives unfavorable result. Corrosion and oxidation tests on the steels containing a suitable quantity of Cu, Cr and Si, or Al were next carried out. These steels show considerable corrosion resistance to various aqueous solutions, and also very high resistivity to oxidation in air at high temperature, which is due to the formation of a stable oxide film on the surface of the steel. The similarity between corrosion in neutral salt solutions containing O diffused from the atmosphere and oxidation in air at high temperature was described. Favorable mechanical properties of these steels are also shown by microexamination and hardness test. Red shortness of Cu bearing steels has been recognized by many authorities to be due to hot work, at a temperature above 1100°, after partial oxidation of Fe in oxidizing high temperature atmosphere, that is, to be due to the increase of Cu-rich phase in the boundaries of crystals on the surface of the steel, but in the present study on the Cu bearing steels containing a suitable quantity of Cr, Si and Al, the above named defect was not expected in the steels, as they have shown fairly good oxidation resistance. TM (13)

Study of Oxide Films on Metal Surfaces with Cathode Ray Diffraction. I. Copper and Its Alloys. Shizuo Miyake. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 14, Aug. 1935, pages 704-713. In Japanese. *Scientific Papers & Abstracts Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 27, Aug. 1935, page 47. In English. Oxide films formed at high temperatures on Cu and its alloys were studied by means of cathode ray diffraction. It was confirmed that the remarkable resistance against oxidation of Al bronze at elevated temperatures is entirely due to the Al_2O_3 film superficially formed. Also a similar property of brass (70/30 Cu-Zn) is due to an oxide film (ZnO) on the surface. WH (13)

Corrosion Resistance of Copper Alloys. N. W. Mitchell. *Metal Progress,* Vol. 28, Dec. 1935, pages 38-41. Discussion of the corrosive applications of common Cu alloys. WLC (13)

Prevention and Removal of Boiler Scale by Electrical Vibrations. L. A. Marshall. *Mechanical World & Engineering Record,* Vol. 48, Oct. 4, 1935, page 333. The Pulso method, consists of applying an oscillating current of rather high potential to the metal of the container. Although there is a heavy connection to earth, the potential of the boiler is sufficiently high to avoid all formation of scale and corrosion. The apparatus only consuming 40 watts, is connected to the a.c. mains and can be fixed to the wall. The protection is limited to the immediate surroundings. The scale already formed is detached under the influence of the electrical potential. WH (13)

The Further Development of Steels Resistant to Weathering (Die Weiterentwicklung witterungsbeständiger Stähle). K. Daeves. *Archiv für das Eisenhüttenwesen,* Vol. 9, July 1935, pages 37-40. Data are given on loss in weight and tensile strength of low C steel wire after 4 years atmospheric exposure in an industrial atmosphere. P contents of about 0.06% and higher materially raised the resistance to weathering of Cu-bearing steel with about 0.4% Cu. The higher weathering resistance of wrought-iron is attributed in part to its generally higher P content. P, especially in Cu-bearing steel, causes the formation of a dark-brown, smooth, non-granular adherent layer of rust which tends to protect the steel from further atmospheric corrosion. Data for steels with about 0.3% Sn do not indicate that Sn is much more effective than Cu in improving the atmospheric corrosion resistance. See also *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 512R/7. EF (13)

Mercurous Nitrate Test. H. C. Jennison. *Metals & Alloys,* Vol. 6, Dec. 1935, pages 348-349. The quantitative use of this test to predict resistance of Cu alloys to atmospheric corrosion is deplored. WLC (13)

The Use of Sodium Sulphite as an Addition to Alkaline Detergents for Tinned Ware. S. Kerr. *Technical Publications of the International Tin Research and Development Council,* Series A, No. 19, 1935, 12 pages. Reprinted from *Journal Society of Chemical Industry,* Vol. 54, 1935, page 217. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 514L/1. (13)

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14. APPLICATION OF METALS AND ALLOYS

Hot Water Boiler Materials (Austauschstoffe für Heisswasserspeicher und deren Installation). H. MUTHREICH. *Elektrizitätswirtschaft,* Vol. 34, May 25, 1935, pages 326-329. Reports on corrosion tests on boiler materials by the Berliner Städtische Elektrizitätswerke. Galvanized sheets and Cu plated Fe failed in service. Very favorable results are reported on Cu hot water boilers tinned on the inside and provided with a steel shell. Cast Fe boilers provided with an acid resistant enamel coating failed in service. Al tubes (99.5% pure) were destroyed due to corrosion after only 6 months operation. Electrolytically oxidized pantal (Al alloy) is not immune to the corrosive conditions prevailing in hot water boilers. Phenol and carbamid-resin tubes showed defects after 6 weeks due to water absorption. Experiments with temperature resistant glass gave satisfactory results. Difficulties in installing the glass parts have been overcome. Special non-metallic insulation materials for glass boilers have been developed. The use of Cu and Cu alloys for hot water boilers has been prohibited in Germany on account of the raw material shortage. WH (14)

Avoid Waste of Material in Parts Design. V. L. MALEEV. *Machine Design,* Vol. 7, Oct. 1935, pages 26-27, 75. Fourth instalment of a 4 part series deals with stress concentration factor index of sensitivity for repeated stresses with reference to 13 ferrous and non-ferrous structural materials and stress load relations. WH (14)

Some Metallurgical Aspects of the Radio Tube Industry. STANTON UMBREIT. *Metals & Alloys,* Vol. 6, Oct. 1935, pages 273-277, 279. High electron emission without evaporation or high vapor pressure of the active metal is required of cathodes. A coating one atom thick of Th, Ce, or Ba on certain other metals gives the desired results. Technique for application and self maintenance of this coating is described. WLC (14)

Strong and Fine Metals Used in the Normandie. MAJORIE RUD HYSLOP. *Metal Progress,* Vol. 28, Sept. 1935, pages 41-44. Lists and describes use of metals of which the Normandie was constructed. WLC (14)

High Grade Heavy and Light Metal Bearing Alloys (Hochwertige Schwer- und Leichtmetall-Lagermetalle). H. REININGER. *Metallwaren Industrie & Galvano Technik, Sect. Werkstoffkunde & Verarbeitungstechnik,* Vol. 33, Apr. 15, 1935, pages 169-170; May 1, 1935, page 218; June 15, 1935, pages 262-263; Aug. 15, 1935, pages 254-257. Discusses the suitability and properties of (1) cast Fe, (2) bearing metals comprising Pb, Sn, Sb and Zn, (3) light metal alloys as bearing metals. (11 most important analyses are given). The alkaline and alkaline earth containing Pb-base alloys are also included. Microstructure, physical properties and analyses are considered. EF (14)

■ 14a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Copper Alloys in Food Manufacture. JAMES T. KEMP. *Food Industries,* Vol. 7, Dec. 1935, page 584. Growth of carbon arc welding of Cu and its alloys has aided in cutting the cost of welded equipment. Alloys such as red brass, Everdur, Tobin bronze and cupro-nickels find many applications where strength and resistance to chemical attack by foods are needed. BWG (14a)

Tin. BRUCE W. GONSER. *Food Industries,* Vol. 7, Dec. 1935, page 585. Various applications of Sn and tinned surfaces in the food industries are covered, giving advantages and limitations. Although attacked by strong bases and many acids, the non-toxicity, lack of deleterious effect on flavor, sanitary appearance and inexpensiveness of tinned surfaces make Sn very satisfactory as a metal for use in contact with foods. Strong alkali and acid cleaners should be avoided. Repairs of tinned surfaces may often be made satisfactorily by metal spraying. BWG (14a)

Weight Savings on A.C. Rail Motor Cars (Gewichtsersparnis bei Wechselstrom-Triebwagen. Allégement d'automotrices monophasées). FRIEDRICH EDELMANN. *L'Allégement dans les Transport,* Vol. 4, May/June 1935, pages 59-63. In German and French. Discusses evolution of the weight saving designs and constantly increasing efficiency of electric rail motor cars of the German State Railroad since 1932. The salient features are shown in 17 illustrations and data on the load capacities of the consecutive designs are tabulated. EF (14a)

Copper, Brass and Bronze. CARTER S. COLE. *Food Industries,* Vol. 7, Dec. 1935, pages 583-584. These earliest metals used for food processing equipment still find many important applications, as in sugar manufacture, fruit and vegetable processing, beverage manufacture and in the dairy industries. High thermal conductivity, ease of fabrication and readiness with which it can be plated are most important characteristics of Cu for this work. Cu is slightly soluble in some foods and, as in the case of milk, must be tinned or otherwise coated to protect food flavors. BWG (14a)

New Uses for Copper Tubing. *Fuel Oil Journal,* Vol. 14, Dec. 1935, pages 10-11. Examples illustrate use of soldered Cu piping instead of threaded pipes of other materials for easy installation in tight corners and for their non-rusting property. Ha (14a)

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14b. Ferrous

M. GENSAMER, SECTION EDITOR

Rocket Propulsion. Willy Ley. *Aircraft Engineering*, Vol. 7, Sept. 1935, pages 227-231. Review of the theory of rocket propulsion and discussion of fuels and temperatures obtained. Critical review of strength of various metals at 1000° C. is given which are tabulated in lbs./in.^{2}, tensile strength for steel 6000, Mo 50,000, and W 15,000. WB (14b)

Metal Clad Insulated Model Home. *Sheet Metal Worker*, Vol. 26, Nov. 1935, pages 510-511. Galvanized Cu-bearing sheets, 28 gage, are used for the exterior, while 28 gage sheets with a specially prepared velvety surface are used for the interior; the latter can immediately take a coat of paint. Details of construction of houses and farm buildings are described. Ha (14b)

Large Uses of Steel in Small Ways. No. 298. Battery Clips. *Steel*, Vol. 97, Oct. 28, 1935, page 43. Describes a specific type of clip which is formed from flat steel and incorporates a coiled spring. One manufacturer alone uses 40-50 tons of steel annually for this purpose. All parts are Pb plated or dipped in hot Pb. MS (14b)

Large Uses of Steel in Small Ways. No. 297. Truck Signals. *Steel*, Vol. 97, Oct. 14, 1935, page 36. Refers particularly to semaphore signals. Numerous small steel parts are used in their construction. MS (14b)

Suspended Monorail System Suggested for Rapid Transit in Congested Center. *Steel*, Vol. 97, Oct. 14, 1935, pages 40, 42. Describes proposed 5-mile double track installation in Queens, New York City. It is estimated that at least 15,000 tons of steel would be required, in addition to that necessary for equipment, stations, and other accessories. MS (14b)

Less-than-Carlot Shipping Containers Gaining Favor. B. K. Price. *Steel*, Vol. 97, Oct. 28, 1935, pages 35, 43. More than 2000 tons of steel are being consumed annually in the manufacture of less-than-carlot containers for bulk and package materials. Discusses particularly air activated containers for handling cement, malt, flour, and similar products, and containers for tiered brick. Former are welded steel cylinders made of black sheets. Tests are being made with stainless-clad steel for containers for flour and other powdered foodstuffs. MS (14b)

Foreign Raw Materials for Special Steels for Chemical Equipment (Beitrag zur Frage der ausländischen Rohstoffe in Sonderstählen des chemischen Apparatebaues). P Schafmeister. *Chemsche Fabrik*, Vol. 8, Oct. 2, 1935, pages 375-380. The sources of supply of Cr, Ni, Mo, Si, Al and Ti are described. The comparative corrosion and heat resistance of stainless steels and substitutes are briefly described. To reduce the amount of stainless steel used, stainless clad sheets are recommended for certain purposes or stainless materials welded onto cheaper base materials at vital points. CEM (14b)

Alloy and Rust-Resisting Metals Find Increasing Sphere on the Railroads. A. R. Wilson. *Railway Age*, Vol. 99, July 27, 1935, pages 117-119. Light weight, high strength, and corrosion-resisting properties make these metals desirable and economical in many parts of rolling stock and fixed structures. Many examples are cited. CBJ (14b)

Rolling, Forming and Welding Are Steps in Making Exhaust Mufflers. W. G. Gude. *Steel*, Vol. 97, Oct. 14, 1935, pages 30-32. Describes practice of Wolker Mfg. Co., Racine, Wis., in fabricating exhaust mufflers for automotive use from flat-rolled steel. MS (14b)

Steel Bridge Cables Spun Like Threads. Andrew R. Boone. *Scientific American*, Vol. 153, Nov. 1935, pages 260-261. Cable-forming operations are described. CBJ (14b)

Links for Mechanical Reheating Furnaces. A. G. Arend. *Machinery*, London, Vol. 47, Oct. 31, 1935, page 127. The links are cast of Cr or Cr-Ni alloy. The sections are sand blasted and machined. Indications are that Cr-Ni binary alloys have better mechanical properties if C is around .5% which reduces percentage of non-metallics. Bolts for securing the sections are best made from Cr-W-V chisel steel. Of 15 other steels tested (not given) Ni-Mo and Cr-Ni-Mo steels were found to be best on basis of greater strength at air temperatures and retained strength at 500° C. The ratio of yield point at 500° C. to ultimate stress at air temperature was used as standard for evaluating the efficacy of alloy additions. WB (14b)

Rustless Steel in New Fields. *Manufacturers Record*, Vol. 104, Sept. 1935, page 30. Hopper cars for coal and other bulky materials and a lightweight merchandise container fabricated from stainless steel are described. CBJ (14b)

Beer Cans—A New Use for Tin and Steel. M. W. von Bernewitz. *Mining & Metallurgy*, Vol. 16, Nov. 1935, page 452. Cans are formed of 30 gauge Sn-plate, lacquered inside and outside. VSP (14b)

Composite Steel for Automobile Body Dies. M. K. Mellott. *Steel*, Vol. 97, Dec. 2, 1935, pages 34-35. Describes development of Jessop Steel Co., Washington, Pa. In making composite die sections, tool-steel insert is cast to desired shape, sand-blasted, and placed in mold where molten low-C steel is poured around it. Ingot is stripped, charged in soaking-pits, and bloomed at 2150° F. Bloom is then cut, ground, and rolled to desired shape and size. Maximum desired properties in both steels are obtained by quenching in brine from 1425°-1450° F. and drawing at 375° F., or quenching in H_2O from 1450°-1475° F. and drawing at 380° F. Steel should remain in quench in each case 1 hr./in. thickness. Use of this composite steel results in substantial reduction of the original and ultimate costs of the dies. MS (14b)

Ferromagnetic Materials for High-frequency (Ferromagnetische Stoffe für Hochfrequenz). A. Weis. *Archiv für Technisches Messen*, Vol. 5, Oct. 1935, pages T139-T140. The properties which a magnetic material must possess for use with high frequencies (radio apparatus) are explained. At present such materials are made up of finest Fe powder of highest permeability which is pressed or cast with a binder into the shapes required in the apparatus. 14 references. Ha (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Patents on Iron and Steel Alloys. 1st Supplement. (Eisen und Stahllegierungen Patentsammlung. 1. Ergänzungsheft). A. Grützner. Verlag Chemie, G.m.b.H. Berlin, 1935. Paper, 7 x 10 inches, 425 pp. Price 44 R.M.

This compilation of patents on iron and steel alloys first appeared in 1932 as part of Gmelin's Handbook of Inorganic Chemistry. In the new supplementary volume, the identical tabular form of the previous one has been retained; patents granted since the appearance of the first volume and some older patents not previously listed have been tabulated. German, English, French, Austrian, Swiss, and United States patents are covered. The tabular form is very simple giving the chemical symbols of the main constituents of the alloy, the range of compositions patented, the properties and uses, year, and patentee. Patents in any particular field are surprisingly easy to locate and this volume and the preceding one will be indispensable to those desiring to make a search of the patent literature. The book also affords an interesting birds-eye view of recent inventive efforts on iron and steel alloys. No patents granted later than 1933 are listed. **Samuel Epstein (15)-B-**

Contributions to the Data on Theoretical Metallurgy. IV. Metal Carbonates—Correlations and Applications of Thermodynamic Properties. K. K. Kelley & C. T. Anderson. *United States Bureau of Mines, Bulletin* 384, 1935, 73 pages. Existing thermodynamic data for carbonates are assembled and, so far as possible, results of decomposition-pressure determinations are correlated with calorimetrically determined heats of formation and entropy values on the one hand and with solubility and standard electrode-potential data on the other. Data are given and discussed for CO_2, CO, H_2O, H_2CO_3, $BaCO_3$, $CdCO_3$, $CaCO_3$, Cs_2CO_3, $CoCO_3$, $CuCO_3$, $FeCO_3$, $PbCO_3$, Li_2CO_3, $MgCO_3$, $MnCO_3$, Hg_2CO_3, $NiCO_3$, NH_4HCO_3, $KHCO_3$, K_2CO_3, $RbHCO_3$, Rb_2CO_3, Ag_2CO_3, $NaHCO_3$, Na_2CO_3, $SrCO_3$, Tl_2CO_3, and $ZnCO_3$. The application of these thermodynamic data to the dissociation of carbonate mixtures and mixed crystals, the purification of solutions of Cu and Zn salts, sulphurous acid leaching of carbonate ores, NH_4Cl leaching of carbonate ores, NH_4Cl roasting of carbonate ores, solution of carbonate ores in H_2O under CO_2 pressure and $CaCl_2$ leaching of carbonate ores is discussed. It is shown that Fe^{+++} may be removed completely from Cu salt solutions by $CaCO_3$ and that Fe^{++} can not be removed by this treatment. The principles and conditions underlying the removal of Fe from Zn-salt solutions by $CaCO_3$ are disclosed. Treatment of low-grade Mn ores with SO_2 solutions is sound provided the Mn occurs as or is converted to oxide. Leaching of $MnCO_3$ ores by NH_4 salt solutions is disadvantageous. At 660° K., the Mn, Ca, and Fe in $MnCO_3$ ores containing $CaCO_3$ and $FeCO_3$ can be converted to chlorides by NH_4Cl roasting. Consideration of various methods for treating Chamberlain (South Dakota) ore show that $CaCl_2$ leaching theoretically is the best. AHE (15)

15a. Economic

Japan's Future Tin Needs. *Tin*, July 1935, pages 4-7. A concise economic analysis is given of the status of the principal Japanese industries, especially those that use Sn in some form. During the world depression, industrial production has increased remarkably, trade has flourished and prices remained quite steady without the problem of unusual unemployment. An increase in the national debt of about a billion dollars is considered not excessive in view of the increased trade and production secured. Although up to the present Japan has imported about 2/3 of her Sn plate requirements, it is estimated that with new plants being built, producing capacity in 1936 should reach 156,000 tons per year, slightly more than has been currently consumed. BWG (15a)

The Future of Tin. *Tin*, Sept. 1935, pages 1-4. The sources of supply of Sn are reviewed. The major producing countries in their order of importance are Malaya, Bolivia, the Dutch East Indies, and Siam; together they produced in 1934, 77% of the world supply. Future developments and consuming countries are discussed. Ha (15a)

Metal Mining in Nevada in 1934—Advance Summary. H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 408, Oct. 9, 1935, 3 pages. Au output in Nevada in 1934 increased 46% over 1933, Ag 166%, Cu 46%, Pb 377%, and Zn 118%. The value of all was $12,359,826, a gain of 127% over 1933. Au production was 144,275.17 oz., Ag 3,057,114 oz., Cu 41,611,117 lbs., Pb 21,981,874 lbs., and Zn 27,880,790 lbs. AHE (15a)

Metal Mining in Oregon in 1934—Advance Summary. H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 407, Oct. 8, 1935, 2 pages. The total value of the Au, Ag, Cu, Pb, and Zn produced in Oregon in 1934 was $1,216,075, the largest since 1920 and 131% greater than the value of the output in 1933. The value of the Au production in 1934 represented 97% of the total value of the 5 metals. Au output was 33,711.59 oz., Ag 46,560 oz., Cu 38,373 lbs., Pb 41,603 lbs. and Zn 73,184 lbs. AHE (15a)

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Mine Production of Gold, Silver, Copper, Lead, and Zinc in Montana in 1934 (Advance Summary). T. H. MILLER. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 413, Oct. 25, 1935, 4 pages. Statistical. AHE (15a)

Chromite Industry in 1934—Advance Summary. H. M. MEYER. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 411, Oct. 22, 1935, 2 pages. Statistical. AHE (15a)

Copper-Zinc Ores in the Urals. S. TONAKANOV. *Tzvetnuie Metallui*, Mar. 1934, pages 3-14. In Russian. Cu-Zn ore deposits in the Urals are of 4 types: (1) Sulphide Zn ores with 4% Zn content, (2) sulphide ores with less than 4% Zn, (3) Cu-Zn ores, and (4) polymetallic ores. The total resources in the Urals are: 730,000 tons Zn and 460,000 tons Cu. Discusses reasons for failure to obtain good yield in selective flotation of Zn-Cu ores, and further study is suggested of flotation by research institutes in coöperation with the Zn-Cu industry. BND (15a)

Manufacture of High-Speed Steels (Fabricación de Aceros rapidos). C. TAMA. *Metalurgia y Construcción Mecánica*, Vol. 1, Oct. 1935, pages 10-11. The possibilities of manufacturing special steels in Spain are discussed. Ha (15a)

Radioactive Minerals (Les Minerais radioactifs). H. BUTTGENBACH. *Revue Universelle des Mines*, Vol. 11, Oct. 1935, pages 449-458. Radioactive minerals contain Th or U which disintegrate spontaneously into a series of products of which mesothorium and Ra are the most important industrially. Th is produced mainly from monacite sands, U from pitchblende, phosphates from Portugal and vanadates from Colorado and recently from ores from the Congo. Deposits, modes of treatment, and measurement of radioactivity are described. Ha (15a)

15b. Historical

From the First Bell of Cast Steel to the Olympia Bell (Von der ersten Glocke aus Stahlguss bis zur Olympiaglocke). H. KALPERS. *Giesserei*, Vol. 22, Sept. 13, 1935, pages 469-473. The efforts to cast bells of steel are reviewed and molding, casting and testing of a big bell for the Olympic games are described. Ha (15b)

Early Silver Plating in America. W. G. SNOW. *Monthly Review*, Vol. 22, June 1935, pages 34-42. Elkington & Co., a Birmingham, England, firm obtained a patent for Ag plating in 1840, and this introduced the art. In this country Rogers brothers, and others experimented, until in 1847 the former began the production of spoons and forks at Hartford, Conn. Much of the early American work was based on English procedure. The article gives the names and accounts of many of the men connected with early Ag plating. GBH (15b)

The Evolution of the Plating Bath. H. J. T. ELLINGHAM. *Electrometallurgy*, supplement to *Metal Industry*, London, Vol. 46, May 17, 1935, pages 539-540. See *Metals & Alloys*, Vol. 6, Nov. 1935, page MA 466. HBG (15b)

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CURRENT NEWS ITEMS

The 1936 Ceramic Meeting

The annual meeting of the American Ceramic Society will be held in Columbus, Ohio, March 29 to April 2, 1936. Columbus is a suitable convention site for a ceramic gathering. It is located in the heart of the ceramic manufacturing world, among localities wherein are manufactured chinaware, stoneware, floor tile, drain tile, sewer pipe, paving and building brick, electrical porcelain, refractories, vitreous enameled ware, and glassware.

Only a few miles from Columbus is located the famous Roseville district, a stoneware center for the production of fine art and utility stoneware. In Columbus are numerous ceramic industries, including the Claycraft Co., one of the country's leading glazed brick manufacturers; Owens-Illinois Glass Co., and the Federal Glass Co., large manufacturers of utility and art glassware, respectively. Also located in this city are several institutions of particular interest to ceramists: Ohio State University, Edward Orton, Jr., Ceramic Foundation, and Battelle Memorial Institute.

Ohio State University had the first ceramic school. It was founded by Edward Orton, Jr. The State University is outstanding not only for it work in technology, but also as a school of ceramic art. The engineering experiment station of Ohio State University, under the direction of Prof. G. A. Bole, is an outstanding ceramic research group. The Edward Orton, Jr., Ceramic Foundation is primarily a manufacturing concern, producing standard pyrometric cones for measuring temperatures in ceramic kilns, but it deals with many research problems. Battelle Memorial Institute is well equipped for laboratory and semi-plant research work. The institute's projects embrace many fields, including ceramics, metallurgy, fuels, and chemistry. The facilities of the institute are also available to industry, under the sponsorship plan, and many industries are taking advantage of this to solve their production and development problems. Arrangements for visiting these institutions have been made by the plant visitation committee.

The Edward Orton, Jr., lecture at the meeting of the Ceramic Society will be given by Dr. W. J. McCaughey, of Ohio State University. Dr. McCaughey has studied ceramic products in respect to behavior in service, especially by the petrographic microscope, and the X-ray. He has had constant contact with manufacturers and consumers of ceramic ware. Open-hearth and blast furnace experts often call on him for advice. Besides his intimate experience with many problems that are troubling ceramic men, Dr. McCaughey is an interesting talker.

J. Erler to Present A.F.A. Paper at Dusseldorf Congress

Johannes Erler, metallurgist, Farrel-Birmingham Co., Ansonia, Conn., has been selected as the author of the American Foundrymen's Association exchange paper to the International Foundry Congress in Dusseldorf, Germany, Sept. 15 to 20. The paper will be entitled "Studies of Casting Stresses in Chilled Iron," and will deal primarily with stresses existing in chilled iron rolls.

The **American Foundrymen's Association** announces the appointment of **Ellsworth O. Jones** as director of its recently formed safety and hygiene section. For the past three years Mr. Jones has been consultant for the industrial relations bureau of the National Founders' Association. He is known widely through his work with national and state organizations in the study of industrial dust problems, with which his work with A. F. A. will largely deal.

How the modern architect uses metals and alloys for building construction, for doors, grilles, railings, and other details, and for decoration and ornamentation, is being shown in the "Metals in Architecture" exhibition by the architects of world-famous buildings now being held in the **Metal Products Exhibits**—the permanent exhibition of metals, alloys, plastics, and finishes in the International Building, Rockefeller Center, New York. The exhibition is open to the public from 10 a. m. to 6 p. m. daily, except Sunday.

Three New Members of Alloys of Iron Committee

Appointment of three representatives of the steel industry to the Alloys of Iron Research Committee of the Engineering Foundation, which is carrying on world research embracing the entire body of knowledge of steel, alloy steel, alloy iron, and cast, wrought, and pure iron, is announced by the director of the foundation, Dr. Alfred D. Flinn:

Dr. John Johnston, director of research of the United States Steel Corp., was named to the committee to represent the American Iron and Steel Institute.

Wilfred Sykes, a director of the Inland Steel Co., becomes a member-at-large, succeeding the late Dr. John A. Mathews, who was vice-president of the Crucible Steel Co. of America.

The other new member is Dr. James T. Mackenzie, metallurgist and chief chemist of the American Cast Iron Pipe Co., who takes the place of R. E. Kennedy, technical secretary of the American Foundrymen's Association.

Wide advances in the use of alloys were reported by the foundation as the result of the scientific investigations which are going on in laboratories in many countries.

The Free Cutting Aluminum Alloy—11S

At the Engineers' Club, New York, on the evening of Feb. 7, a dinner was given by the Eastern Division of the Screw Machine Products Association, for which the Aluminum Company of America furnished the post-prandial program. There were about 125 in attendance.

After a splendid introductory address on "Aluminum Fabrication," by S. K. Colby, vice-president of the company, various technical phases of the production and use of the Aluminum company's new free cutting alloy, 11 S, were discussed by representatives of the company, as follows: "Aluminum Alloys for Screw Machine Products," by L. W. Kempf, Cleveland; "Properties of the New Free Cutting Aluminum Alloy," by A. Hartwell, of the Edgewater, N. J., plant, and "Automatic Screw Machine Practice for the New Free Cutting Aluminum Alloy," by J. F. Coneen, also of the Edgewater plant.

Dr. Norman A. Shepard has been appointed director of technical service for the **American Cyanamid Co.,** the American Cyanamid & Chemical Corp., and other companies in the cyanamid group where coöperation in this field is required. He will be responsible for directing the technical service laboratories located in Stamford, Conn., the expansion of the sales service laboratories to meet present and increasing need and the coördination of the technical and sales service work in all of the several divisions of the above-named companies.

Dr. Shepard is a graduate of Yale University (Ph.D. 1913), was assistant professor of chemistry at Yale from 1917 to 1919 and has been director of the research laboratories of the Firestone Tire & Rubber Co. His headquarters are at the Stamford laboratory.

Robert E. Kinkead, consulting engineer on welding, whose numerous articles on the subject have appeared in leading technical and trade papers, has been retained by the Carnegie-Illinois Steel Corp. to make a survey of its welding operations. Mr. Kinkead is a mechanical engineer, Ohio State, 1913, and has specialized in welding throughout his career. Since 1927 he has been engaged in professional consulting work for a number of engineering and manufacturing companies, who are large users of welding.

Announcement is made by **E. F. Houghton & Co.,** manufacturers of oils and leathers, Philadelphia, that **L. D. Holland,** formerly sales manager of the western division, has been made manager of research development, with headquarters in the general offices, Philadelphia. **A. A. Miller,** formerly head of the Cincinnati office, has been promoted to the position of western sales manager, with headquarters in San Francisco, Cal.

MANUFACTURERS' LITERATURE

Motor-Operated Controllers

Relatrol—Type 3D and Balancer—Type 3E are discussed in an illustrated leaflet. Relatrol is applied for processes where loads are constant or but moderately variable while the Balancer applies with equally precise results regardless of load changes, according to the manufacturer. Automatic Temperature Control Co., Philadelphia, Pa. (224)

Yoloy

A colorful bulletin summarizes the properties of the above alloy steel and lists the physical properties of two typical steels in the Yoloy series. It is claimed to be corrosion resistant and to have high tensile strength and high ductility. Youngstown Sheet and Tube Co., Youngstown, O. (225)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. It is claimed that this series represents the best straight cutting oils obtainable, at a price which meets and beats competition. E. F. Houghton & Co., Philadelphia, Pa. (226)

The Characteristics of Burning Gas With Preheated Air

This illustrated bulletin summarizes six progress reports, each covering in detail a specific branch of this subject, presenting both the theoretical and experimental phases of the problem as disclosed by the investigation. American Gas Association, New York, N. Y. (227)

Grinding for the Railroad Shop

The trend toward improvements in convenience, passenger comfort, service and speed calls for greater mechanical perfection in equipment. As grinding is the recognized means of obtaining accurate, close-fitting and long-wearing parts at minimum costs it is rapidly coming into more general use by the railroads according to an attractive pamphlet of the Norton Co., Worcester, Mass. (228)

Cor-Ten and Man-Ten

Pamphlet describing high-tensile steels developed to meet the need of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (229)

Arc Welding

A book "Automatic Arc Welding by the Electronic Tornado" gives a full explanation of this system of automatic carbon arc welding for use in industries where products of relatively uniform character are produced in large quantities. Lincoln Electric Co., Cleveland, O. (230)

Blast Gates

Looseleaf page No. 353 is devoted to this company's Kwikleen gates, which, it is claimed, can handle low pressure air and liquids carrying a large percentage of solids, which would clog or jam an ordinary gate, and are styled to suit the service. W. S. Rockwell Co., New York, N. Y. (231)

Spencer Turbo-Compressors

This bulletin which has illustrations of the complete range of sizes of this equipment also contains: "Midget" Turbo for individual mounting, a single-stage line which effects new economies and Gas-Tight Turbos for acid and explosive gases. Spencer-Turbine Company, Hartford, Conn. (232)

Wheelabrator Tum-Blast Cleaner

This cleaner, which it is claimed sets the highest standard of efficiency ever attained in an abrasive cleaning machine is a combination of the Tum-Blast Cleaner, a pressure blast machine, and the airless abrasive cleaning device, Wheelabrator. Book 111 is devoted to it. American Foundry Equipment Co., Mishawaka, Ind. (233)

Refractory Mortars and Plastics

Bulletin R-1-D contains brief descriptions of the two mortars and three plastics which, it is claimed by the manufacturer, comprise a group designed to meet all furnace conditions. A reference table showing which material to use for certain types of work is included. Illustrated. Babcock & Wilcox Co., New York, N. Y. (234)

Carbofrax

Leaflet illustrating Carbofrax standard brick shapes and plain tile. Tables of sizes. The Carborundum Company, Niagara Falls, N. Y. (235)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-ray has now come to the fore as a tool of the testing laboratory. Kelly-Koett Mfg. Co., Inc., Covington, Ky. (236)

Muffle Furnaces

The construction, control and operation of the Alloy 10 furnace are described in a pamphlet which claims that this furnace is efficient for all laboratory operations requiring temperatures to 2400 deg. F. Illustrated. Hevi Duty Electric Co., Milwaukee, Wis. (237)

Heat and Corrosion Resistant Alloys Heated by Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (238)

Polishing Machines

A portable model and a floor model of these new metallographic machines are described and illustrated in a pamphlet from Eberbach & Son Co., Inc., Ann Arbor, Mich.

Published by the same firm: "Electrolytic Machine" designed on the Unit Power-Contained System for effecting electrolytic deposits. (239)

The Jetal Process

Simple immersion in an aqueous bath for about 5 minutes colors all grades of common iron or steel a brilliant and uniform jet black. It is claimed it does not alter dimensions of articles and cannot chip, scale, peel or discolor. Alrose Chemical Co., Providence, R. I. (240)

Konik

Data on this steel's physical properties, corrosion resistance and working, are offered by the Continental Steel Corp., Kokomo, Ind. (241)

Bimetal

A simplified version of its manufacture, and the way it works is contained in this pamphlet. W. M. Chace Co., Detroit, Mich. (242)

B & L Steel Shafting

This attractive leaflet states that you are assured of close adherence to size tolerances, concentricity and straightness, the maintenance of uniformity and freedom from imperfections in B. & L. Shafting. Bliss & Laughlin, Inc., Harvey, Ill. (243)

A. W. 70-90

This bulletin describes the new high-strength "70-90" steel in sheets and plates. An article on the engineering aspect of high-strength sheet steels is included. Alan Wood Steel Co., Conshohocken, Pa. (244)

High Speed Furnace

Juthe furnaces for heat treating high speed steel are adapted for almost any heat-treating operation up to 2500 deg. F. Control of quality, increased production, closer limits of accuracy and better working-conditions are claimed by the manufacturer as results of their use. American Electric Furnace Co., Boston, Mass. (245)

Smoke-Density Recorders

This equipment measures smoke density at the stack, indicates and records it wherever needed and signals major changes if desired, according to the manufacturer. The construction is rugged, automatic in operation and provides clear, fileable records as well. Leeds & Northrup Co., Philadelphia, Pa. (246)

Electric Furnaces

Pages 5 and 6 from Leaflet TD 23 discuss Types "B," which has a cast alloy steel hearth and "BA" which has a refractory or heat resisting alloy hearth. Designed for laboratory work, the heating elements can sustain 2400 deg. F. Thermometer and thermocouple calibration tanks and furnaces also discussed. Harold E. Trent, Philadelphia, Pa. (247)

Welding Rods

Hard-facing welding rods Nos. 459 and 217 are the subjects of an illustrated brochure. Hard surfacing can be done with these rods, either electrically or by the oxy-acetylene process to the great majority of ferrous welding parts. American Manganese Steel Co., Chicago Heights, Ill. (248)

Abrasion Resisting Steel

AR Steel was developed to meet the demand for a low priced abrasion-resisting steel. Physical characteristics and chemical analysis are included in this illustrated pamphlet which also contains tables of the sizes in which it is available. Carnegie-Illinois Steel Corp., Pittsburgh, Pa. (249)

Weatherproof Line Wire

Publication GEA-2103 gives information on a new wire with varnished cambric and a weatherproof braid treated with U.R.C. compound, General Electric Co., Schenectady, N. Y. (250)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (251)

MANUFACTURERS' LITERATURE

Free Cutting Brass Rods

Anaconda publication B-14, second edition, lists in detail the advantages of brass for screw machine products. American Brass Company, New York, N. Y. (305)

Potentiometer Controllers

Bulletin No. 202 covers the complete line of potentiometer and resistance thermometer controllers. A number of simplified wiring diagrams showing how an installation looks are included. Foxboro Company, Foxboro, Mass. (306)

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat-treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (307)

Centrifugal Compressors

Bulletin 386 is devoted to this company's Design 9 Compressors. Illustrated. B. F. Sturtevant Co., Boston, Mass. (308)

Permite Six Foot Cast Bronze Bars

An attractive booklet states that these bars assure a product identical in physical and wear resisting qualities with the finest individual castings. Data on uses and properties of various bronze alloys are included. Joseph T. Ryerson and Son, Inc., Chicago, Ill. (309)

Centrifugal Castings

Bulletin C-2 is devoted to these castings which are available in the same analyses as the stationary-cast range of heat and corrosion resistant alloys which they supplement. Michigan Steel Casting Co., Detroit, Mich. (310)

Electric Furnaces

A pamphlet describes the "Certain Curtain" furnace which was developed for heat treating at temperatures between 1850 and 2500 deg. F. C. I. Hayes, Inc., Providence, R. I. (311)

Thermal Expansion Characteristics of Some Nickel Cast Irons

The above article is reprinted in Section 3, No. 6 of the Nickel Cast Iron Data leaflets published by The International Nickel Co., Inc., New York, N. Y. (312)

Duraloy

The various types of Duraloy are described and physical properties and working data given in a colorful leaflet. The Duraloy Company, Pittsburgh, Pa. (313)

Lithorizing

Leaflet setting forth this process for making paint hold to galvanized iron. American Chemical Paint Co., Ambler, Pa. (314)

Stellited Valves

The manufacturer claims that these valves last six to ten times longer than other valves and cites cases to prove it. It is stated, in a colorful and well-illustrated bulletin, that Haynes Stellite is a non-ferrous alloy of cobalt, chromium and tungsten, so hard that no ordinary tool steels can cut it. Haynes Stellite Company, Kokomo, Ind. (315)

Simplified Optical Pyrometer

Catalog No. 70 describes the new Pyro Optical Pyrometer which, it is claimed, is totally self-contained, direct reading and has no correction charts or curves. It can be furnished with various scale ranges to meet all plant and laboratory requirements. Illustrated. Pyrometer Instrument Co., New York, N. Y. (316)

Micro-Projectors

Micro-Projectors are used to demonstrate microscopic characteristics to groups of people interested in industrial and commercial work. By their use a highly magnified image can be projected to a screen, and a group can see what could have been seen by only one person at a time, before. Different types are described and illustrated. Bausch & Lomb Optical Co., Rochester, N. Y. (317)

Temperature Indicating and Control

A bulletin contains information on the no contact system of temperature control which introduces a radio principle which does away with mechanical devices in the control instrument. Thermo Control Devices, Inc., Chicago, Ill. (318)

Torsion Impact Testing Machine

Bulletin No. 114 discusses the Carpenter machine whose operation is very simple and requires only one operator. Baldwin-Southwark Corp., Philadelphia, Pa. (319)

Save-Lite

This catalog, prepared with the cooperation of the Better Vision Institute and Better Light-Better Sight Council presents painting as a part of lighting and plant conditioning. Illustrated. Sherwin-Williams Co., Cleveland, O. (320)

Apparatus for Testing Petroleum Products

Detailed specifications, references to governing standards, and information on general utility apparatus are included in this new catalog, No. 160. Precision Scientific Co., Chicago, Ill. (321)

Magnaflux

This system of inspection is described in a colorful folder, which illustrates four typical magnitizing units used in this process. No special skill beyond that of the average inspector is required. Magnaflux Corp., New York, N. Y. (322)

Lindberg Control

Bulletin 41 is devoted to this control, whose function it is to balance the rate of heating of a furnace or oven with the varying heat requirements. It eliminates temperature lag and overshooting, according to the manufacturer, and its other advantages are described. Lindberg Engineering Co., Chicago, Ill. (323)

Standard Gas Fired Air Heaters

Publication SC-70 is devoted to these heaters which, it is claimed, are applicable to all low temperature heating operations which may be accomplished by the circulation of heated air and where contact of the material being heated with diluted products of combustion is not objectionable. They may be applied to batch type or continuous ovens or kilns, rotary or cylindrical dryers, towers, rooms or any enclosed space in which heating or drying is to be done. Surface Combustion Corp., Toledo, O. (324)

Republic Double-Strength Steel

A booklet entitled "Agathon Alloy Steels" includes information on the analysis, physical properties and uses of the Double Strength Steels. Illustrated. Republic Steel Corp., Cleveland, O. (324)

Ladle Fluxes

The advantages of using fluxes for aluminum, brass, bronze, copper, nickel, iron and special alloys are listed in a leaflet of The Maluminum Co., Indianapolis, Ind. (326)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (327)

Brazing Alloy

Bulletin No. 5 advocates the use of "Sil-Fos" for joining brass, bronze, nickel, nickel silver, extruding brass and bronze. Monel metal and other non-ferrous metals and alloy fusing above 1300 deg. F. Handy & Harman, New York, N. Y. (328)

Radium for Industrial Radiography

This article, written by R. A. Gezelius and C. W. Briggs, containing interesting and important information on the subject, is published in handy booklet form. Radon Company, Inc., New York, N. Y. (329)

Granite City HS Grades 1 and 2

Information concerning the Granite City manganese high tensile steels can be obtained from the Granite City Steel Co., Granite City, Ill. (330)

Heat and Corrosion Resistant Alloys

This bulletin lists a number of alloys, stating nickel and chromium content for each grade, and indicating the general field of application. Illustrations of commercially-used materials and the applications listed are claimed by the manufacturer to be the result of long and proven practice. Michiana Products Corp., Michigan City, Ind. (331)

Refractories

The manufacturers of Shamva Mullite claim it is a super-refractory because it has a definite high melting point, great resistance to sudden changes of temperature and other features. The Mullite Refractories Co., Seymour, Conn. (332)

High Temperature Creep Values of Low Priced Alloy Still Tubes

Up-to-date circular which supersedes Circular Letter No. 2A, Nov. 1, 1933, bearing the same title. The Calorizing Co., Pittsburgh, Pa. (333)

Char Carburizing Compound

The manufacturer claims that because of its low dusting loss, low shrinkage and continuously uniform activity this compound results in marked economies in the carburizing of steel. Char Products Co., Indianapolis, Inc. (334)

Illium-G

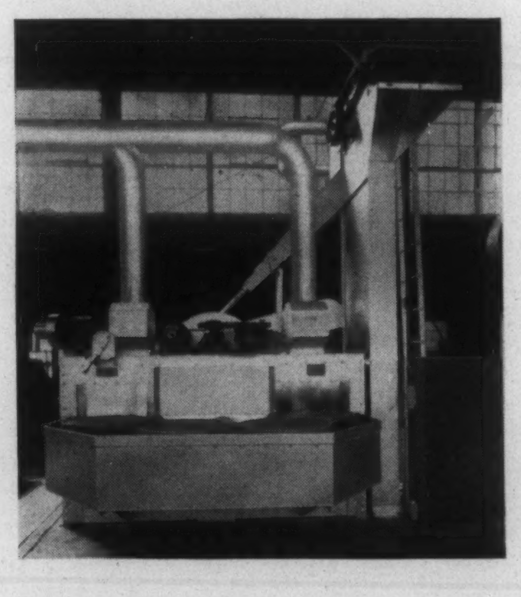
Leaflets setting forth data on this product which, it is claimed, is strong, tough and hard and possesses these qualities in proportions that fit it excellently for a wide variety of uses. Illustrated. Burgess-Parr Co., Moline, Ill. (335)

NEW EQUIPMENT AND MATERIALS

Wheelabrator Multi-Rotary Table

The American "Wheelabrator Multi-Rotary Table" has been announced by the American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Ind. It consists of a number of independent tables (the number and diameter of tables can be varied). A guide under the center of each table runs in a track, which, directly under the Wheelabrator runs in a straight line for about 6 ft. This directs the tables under the Wheelabrator blast, so that the work will obtain the full effective blasting range of the abrasive as it leaves the wheel. The flat vertical side of the table contacts a moving belt revolving the tables as they pass under the blast. The speed of this belt is variable so that the speed of turning the tables can be varied as well as the speed of their travel under the Wheelabrator. After traveling under the blast, the tables follow the track out of the cabinet where the material can be removed or turned over for a second application under the Wheelabrator.

Certain types of castings, forgings or stamped metal parts are cleaned more satisfactorily on a table type abrading machine than in the tumbling type. Fragile pieces or parts which would be scratched or injured in the tumbling process fall into this class. Until recently, when the Wheelabrator was developed, only air pressure table equipment was available. The multi-rotary table operates at 1/5 to 1/10 the cost of operating air equipment and the result claimed is a uniformly cleaned surface. There is no streakedness. Vertical sides of any parts up to 5 in. high are perfectly cleaned.



Cycle of operation of the Wheelabrator with the multi-rotary table consists of an abrasive load in an overhead hopper. From the hopper the abrasive is fed, via a chute and control gate, to the center of the patented wheel. By centrifugal force the abrasive is thrown from the blades of the wheel onto the work to be cleaned or prepared. The abrasive is controlled as to volume and direction of blast so that any type of cleaning and preparation can be accomplished, from light metal parts requiring a satin finish to heavy castings or forgings needing dirt or scale removed. Use of selected sizes and types of abrasive regulate the cleaning or preparation selection.

The "Dustube Collector"

What is claimed to be the most practical and simplest operating dust collector ever built, is announced by The American Foundry Equipment Co., 555 Byrkit St., Mishawaka, Ind., and is called "The American Dustube Collector." It is simple in design, with no efficiency lost, but rather greater effectiveness gained.

The heart of the "Dustube Collector" is the long tube made of special woven fabric best suited for filtering of ordinary dust, and this fabric can be changed to suit the specific installation. The tubes are hung from racks in the ceiling. Self-acting dust seals hold the tubes to the bottom, without clamps, bands, or intricate devices. The seal is as positive in operation as it is simple in construction, and there is no leakage of dust. Spring suspension of the dust tubes maintain the proper tension on the cloth making it easier to insert or take out dust tubes when desired.

In this multiple tube design every tube works independently. In the case of a damaged tube, it can be easily unhooked, rolled up and placed in the inlet seal at the bottom, thus sealing the opening temporarily, without interfering with the operation of the complete equipment. All tubes are easily accessible and new ones can be inserted in less than five minutes.

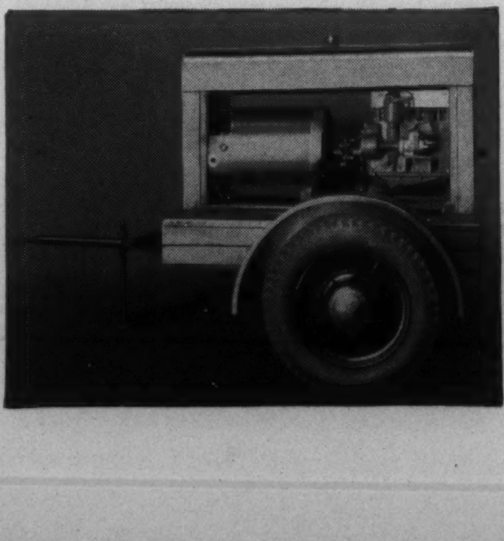
The tubular design of the American Dustube Collector, it is claimed, insures low operating and maintenance cost. Because of the large air chamber and the open design of the tube inlets, the suction within the casing is very low. This not only means a larger saving in fan horse power, but there is less wear by erosion on the interior of the equipment. Also, this design eliminates the possibilities of stacking or caking of dust in the tubes which would retard efficiency, increase fan horse power consumption and increase the maintenance cost.

New General Utility Welder

An entirely new P&H-Hansen arc welder of 150-amp. capacity, announced by the Harnischfeger Corp. of Milwaukee, is pointed to as noted for the unusually high electrical efficiency developed with the small air-cooled gasoline engine which powers it. Known as the Model W-150, this new welder, designed to cover a broader range of welding jobs, uses bare or coated electrodes from 3/32 to 3/16 in. for welding materials of varying thicknesses. Welding is simplified through single current control accomplished by shifting brush holders for current settings over the entire welding range.

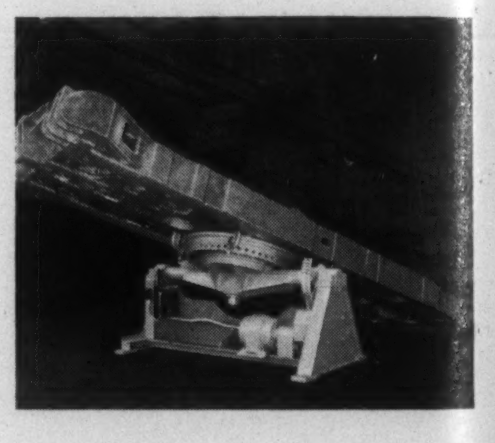
For field service, the standard unit can be mounted on a two-wheel highway trailer to travel safely behind an automobile or truck at average motor car speeds. The trailer has sturdy, all-welded construction with engine and generator protected from road shocks by automotive-type cantilever springs and balloon tires. The W-150 is also available on small four-wheel industrial truck or for factory use with skid mounting.

Electric motor equipped models, either stationary or portable, are driven through a V-belt drive either stationary or on 2-wheel truck. Gasoline motor equipped units are driven direct-connected at 2200 r.p.m., mounted on steel base. The generator is of standard P&H-Hansen design with patented internal stabilizer winding which provides unusually high arc efficiency without the use of external resistors, reactors or separate stabilizers.



New Welding Positioner to Speed Work

An outstanding example of the new type of equipment coming to the front to put welding on a more efficient basis, is the new "P-10 Welding Positioner" developed by the Harnischfeger Corp., Milwaukee. This new unit with a tilting turntable arrangement handles pieces up to 4 tons, enabling the welding operator to keep work in proper welding position with a minimum of time and effort.

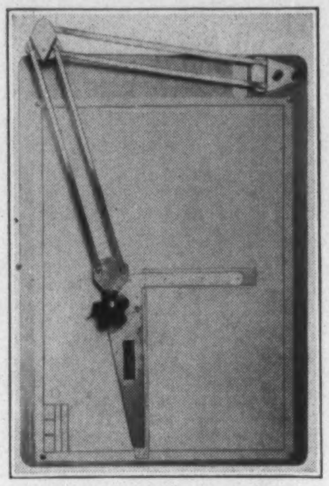


This demand for faster and easier handling comes with the rapidly increasing use of the electric arc welder as a production tool. Cost studies reveal that where shops are not equipped with proper handling facilities, welding operators are, on an average, spending as high as 75% of their time maneuvering clumsy pieces with less than 25% of their production time depositing metal.

The new Harnischfeger P-10 welding positioner has a 48-in. revolving table which is manually operated, turns on roller bearings, and is self-locking in 50 positions. The table tilts 90 deg. in one direction and 45 deg. in the other. Tilting mechanism is electric motor driven through a double reduction bronze worm gear so that it moves smoothly and can be accurately stopped at any angle with electric push button control. Motor is supplied for either AC or DC operation, limit switch controlled. With 4-ton capacity and a safety factor to carry up to 25% overload, this new unit permits faster handling of pieces of all sizes and shapes to keep work always in an upright welding position for the proper flow of molten metal.

"Wrigraph" Drafting Machine

The new "Wrigraph Model E-272, is one of the complete line of fine drafting machines manufactured by L. G. Wright, Inc., 5711-14 Euclid Ave., Cleveland. It is a newly designed, streamlined drafting machine, mounted on a 22 in. by 30 in. cleated, white pine board. The parallel mechanism is hand-assembled with all steel nickel-plated parts and solid phosphor bronze bearings. This mechanism is calibrated for accuracy and completely guaranteed. The Model E-272 is equipped with a vernier indicating protractor reading to degrees. The protractor unit has a unique chuck plate to hold the new streamlined drawing attachments in perfect alignment. The graduated L-square blade is made of pyroxylin and riveted to a lightweight aluminum stiffener which has been given a satin finish to eliminate glare. The drawing edges of this blade are transparent.



This professional model was developed to fill the need by technical men for a moderately priced, accurate drawing machine making drawings up to 20 by 26 in.

The Deblanchal Rotary Melting Furnace

The Deblanchal rotary melting furnace, offered by the Amsler-Morton Co., Pittsburgh, was designed and developed by three engineers, Messrs. Delot, Blanchard and Pigal, employed in the Amsler-Morton, French organization, known as Fours et Fumisterie Industrielle of Paris, France. Prior to offering this furnace to American foundrymen, a thorough investigation of its performance abroad revealed advantages claimed to surpass all other furnaces of the general type and other melting methods.

The furnace has been built in a wide variety of sizes for the melting of gray and malleable iron, steel, alloys and non-ferrous metals. Most industrial fuels of high calorific value may be employed; fuel oil makes, perhaps, the most desirable, due to its freedom from solids. This feature permits the use of recuperation, effectively, and efficiently throughout the life of the lining. Preheated air speeds up the melting cycles. Fuel is utilized most economically with preheated air and the maximum turnover from a given investment is assured. The time required to produce a melted charge, employing preheated air and fuel oil, is approximately 70 min.

The body of the furnace is made of heavy steel plate welded together and substantially bound by tees and angles. The conical ends are similarly constructed with welded steel ribs to prevent deformation. A removable pouring spout is bolted in the center of the furnace shell, so situated that the metal will be drawn from the lowest part of the furnace. A preheated air inlet is provided at one end of the furnace, movable to one side, to furnish a large opening for charging the furnace shell with raw materials. In this preheated air inlet, an inspection aperture is provided for the operator to watch the progress of melting, and procure samples. Additional alloying of the melt is done without interrupting the rotation of the furnace, through the same opening.

The furnace is equipped with two steel tires mounted on a cast iron frame which in turn is riveted to the steel plate shell. These tires are supported on steel wheels which are carried on cast iron bases through adjustable bearings. The cylinder is rotated by means of a girth gear securely fastened to the drum through a spur gear, a set of bevel gears and a reduction gear unit complete with motor. The furnace rotates at a speed of 1 r.p.m. to retain the molten bath level at all times in the furnace.

A recuperator, having a slag chamber, provides preheated air for combustion. The recuperator receives the gases which pass out of the furnace and heats the air entering the recuperator to a temperature of 500 deg. F. Preheated air enables fuel to burn with less excess air. There is less oxidation loss in the Deblanchal furnace; in practice, this loss was found to be 1.5% as compared with 5% loss in direct fired types. The faster melting cycle is important in reducing these losses to a minimum. Any kind of fuel of high calorific value may be used. Fuel oil is preferred for its faster melting rate, and to eliminate ash from the recuperators.

The furnace is charged by means of a small hand or mechanical charging implement which enters through the cone end of the preheated air inlet and the burner carriage, which is swung open to the charging position. The charging implement holds the raw materials and carries them to the furnace. No specific plan of loading the charger or dumping within the furnace is necessary. The furnace can be charged in 15 to 20 min. After charging, the air inlet is moved into position and the heat is turned on.

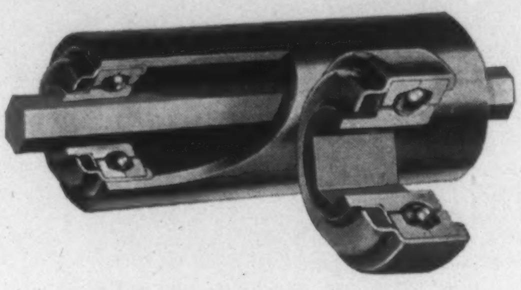
Quick melting is caused by the high flame temperature of the gases over the charge in the furnace, causing the metal to fuse and flow down the inclined surface to the bottom, forming a bath, which leaves a new surface to come in contact with the heat. This method of melting prevents overburning or oxidation. After the entire charge is melted, the furnace is revolved, placing the incandescent brick lining of the upper half of the furnace underneath the bath, and allowing the cold brick to become heated. Then, when the rotation of the furnace becomes continuous, the white hot lining from above is carried below the bath, thereby delivering its heat from below, as well as the radiation of the heat from the upper walls of the furnace.

The Deblanchal furnace can be built in capacities of 1000 to 24,000 lbs. metal capacity (½ to 12 tons). One man can operate the furnace with the occasional aid of a helper.

The advantages to be realized from the use of this furnace are claimed as follows: 1. Low operating cost; 2. Lowest cost per furnace, fuel and metal per ton; 3. Simplicity in operation; 4. Low oxidation loss due to controlled atmosphere in the furnace; 5. Wide range of products; 6. High temperature of pouring iron permits making of thin sections; 7. Furnace adapted for duplexing; 8. Poured metal is free from slag; 9. Metals of exact analysis are produced; 10. Lower power consumption; and 11. Faster melting.

Ball-Bearing Roller Conveyors

For over 30 yrs. the Mathews Conveyer Co., Ellwood City, Pa., has been a leading manufacturer of ball bearing roller conveyers. In accordance with company policies to continue improvements, the Mathews company now announces an addition to their "knurled-keylock" line of roller conveyers in the form of rollers incorporating "hexagon" shaped axles. This addition will grace practically all the present sizes now available plus several intermediate sizes not heretofore available. The new line will appear in form similar to the illustration. Seamless steel tubing, hardened steel bearing parts, solid steel inner and outer ball races predominate. Ball bearing rollers in lengths to suit are available in diameters from 1 to 7⅝ in., with capacities ranging from 50 lb. continuous load rating for the 1 in. diameter roller to 8000 lbs. for the 7⅝ in. diameter roller.



Iron Plates for Paving

Interlake Iron Co., Toledo, Ohio, has announced that contracts totaling $100,000 have been let and work begun on its new plant for the production of iron paving plates. It will be the first plant of its kind in the United States.

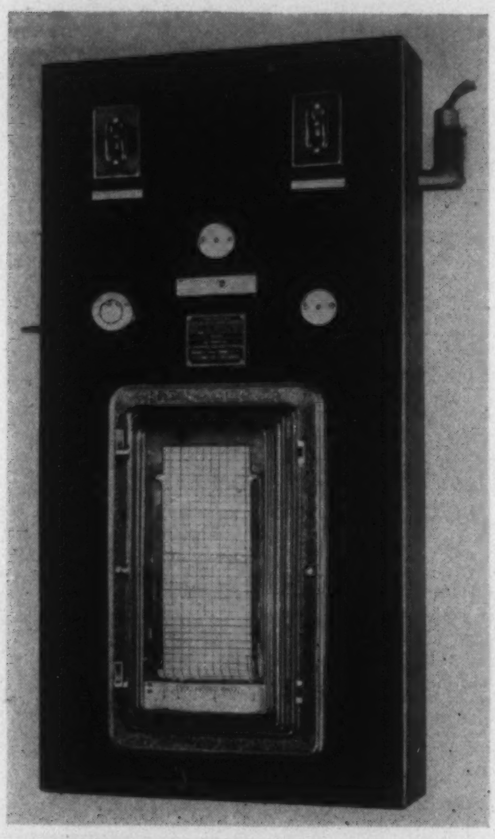
The new form of paving was one of the big features of the Highways Exposition recently held in Cleveland. It is reported to be virtually non-skid and wear-proof. Exhaustive tests have proved iron plate paving to be as much as five times more durable than other paving material, outwearing even granite blocks. It is also said to reduce wear on automobile tires. In price, the iron paving compares favorably with brick, asphalt and other materials. It has been used successfully in Europe for a number of years.

The iron plate is constructed in the form of a 10½ in. triangle and is 1⅜ in. in overall thickness. Around the outer edge of the bottom of the plate is a flange about 1 in. deep and ½ in. thick, with air space in the center for anchoring in a concrete base.

E. L. Clair, General Manager of the Toledo firm, stated that the present expenditures were for a preliminary plant which, if the product meets with the public response anticipated, will lead to a huge development in Toledo.

New Gas Analyzer for Prepared Atmospheres

It is now possible to continuously and automatically analyze prepared atmospheres in a simple and highly dependable manner by means of the stationary "Model REA Analyzer" of the Bacharach Industrial Instrument Co., Pittsburgh, Pa. For atmospheres neutral or reducing in character, the analyzing unit recommended measures the unburned gases present in the prepared gas; where oxidizing atmospheres are involved, or where the atmosphere is varied between an oxidizing and a reducing condition, a combination atmosphere recorder is furnished for analyzing oxidizing, neutral or reducing atmospheres.



Several installations have been made in connection with inert gas generators which, it is claimed, have proven highly useful, both for guiding the operators and recording the gas composition at all times.

The analyzing unit furnished for reducing or neutral atmospheres uses the catalytic properties of a heated platinum wire to burn reducing gases and at the same time measures the heat liberated, by means of a bridge circuit. The unit for oxidizing atmosphere analysis measures the heat conductivity of the gas sample, and for this measurement employs a highly improved thermal conductivity cell.

The gas analyzer is said to constitute a radical improvement over the usual methods of gas analysis. Novel features announced include high velocity sampling, analyzing system under positive pressure, and unusually close zero stability. Highly rugged construction is also featured. The maintenance requirements are claimed to be negligible.

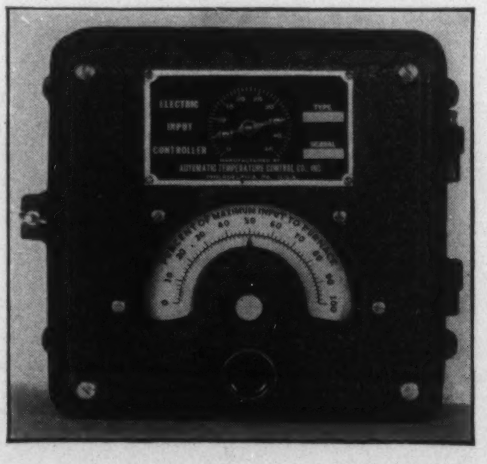
A New Input Controller

Experience gained in pioneering with current input control has enabled this company to produce a new controller, based on proved design but more flexible in adjustment and more accurate in setting. Finer regulation is offered not only in replacement of rheostat control but in combination with existing automatic control.

Four standard models have been produced to meet various requirements: Model M is designed to prevent a constant load from rising in temperature beyond a desired and readily adjusted setting; Model MT exercises the same control of overshooting as Model M but, in addition, is provided with built-in time control which brings input-control into action after an adjustable period. Models F and FL are designed for control where loads are variable. Both models adjust automatically to changes in demand, with Model F serving installations having but slight lag in furnace response and Model FL serving where lag is greater.

Where furnace load is constant, Model M input controller is used, wired in series with low pyrometer contact. One setting of the input controller then governs current input so that the charge is held at the desired temperature. Full current is applied at intervals so accurately apportioned that deviations from the control setting are minimized.

In the case of variable load, Model F or FL is used, so wired that the rate of current input is automatically decreased or increased by the high and low contacts of the actuating pyrometer. Choice between the two models is made in accordance with lag characteristics of the furnace and heat-control equipment. Where response of the furnace to change in current input is prompt, as where a fine-wire thermocouple and/or internal circulation is provided, Model F is selected. Where lag is greater, as in the usual case, Model FL is recommended.


ELECTRIC
INPUT
CONTROLLER
TYPE
SERIAL
AUTOMATIC TEMPERATURE CONTROL CO. INC
PERCENT OF MAXIMUM INPUT TO FURNACE
0
10
20
30
40
50
60
70
80
90
100

Current Input Controllers provide improved temperature regulation for batch heating in the heating-up period, in the soaking stage, or in both, as required.

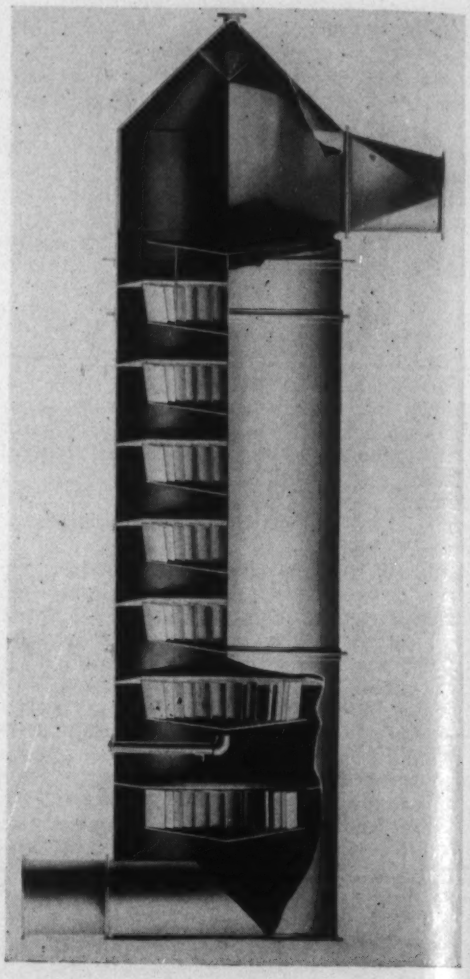
Resistor Type Rocking Furnace

The Detroit Electric Furnace Co., Detroit, announces the preliminary test and manufacture of a "Resistor Type" rocking furnace. This unit is expected to be especially useful for low temperature melting operations and may have special value in the chemical field. The broad principles of the furnace are old, the rocking mechanism and control being similar to that already used on present-day Detroits. To the Detroit rocking furnace mechanism a resistor element has been adapted by mounting a graphite resistor on the central axis of the furnace and connecting it to a special transformer. It is expected that unusual temperature flexibility and control will be derived by this means.

According to a statement by the company, equipment of this type has been built and is being tested for operating results to better evaluate its usefulness in the melting field. If successful, it is expected that units in several sizes will be promptly offered to the United States market.

Schneible Dust Collector Improved

The Claude B. Schneible Co., 3951 Lawrence Ave., Chicago, dust collector engineers, announce an improved line of wet dust collectors. Its improved wet collector towers, similar in external appearance to those previously offered, are now made with six dust impingement plates; the seventh of the series being designed for use as a water entrainment separator to gather the remaining moisture from the clean air before it is exhausted.



Other major design changes include a dirty air baffle under the first impingement plate, wearing strip reinforcing, an air directional baffle on the inlet side in the cyclone chamber, and a screened strainer on the sludge discharge line.

This improved design has been made to better cope with dust hazard conditions in foundries and other industrial plants having dust or fume conditions that are injurious to workers' health and, because it employs the wet method of dust suppression, it is claimed to solve this problem in a most simple way.

Novel Signaling System for Strip Mill

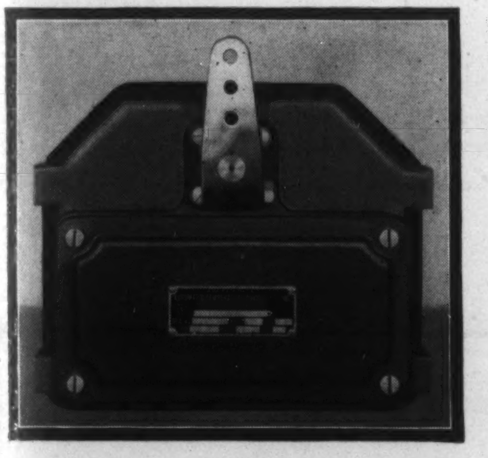
An ingenious signaling system for communication between the inspector and strip mill operator has been installed on the Youngstown Sheet & Tube Co's. new 79-in. continuous hot-strip mill at Campbell, Ohio. Employing the synchro-tie principle developed by the Westinghouse Electric & Mfg. Co., the system provides the inspector with a means of reporting deviation from the accepted quality of the strip so that the necessary correction may be made by the operator.

Two identical inspectors' transmitters are located at the coiler and piler, since the inspector will be at one or the other location depending on whether the strip is being coiled or cut into short lengths and piled. The receiver is located at the operator's station and is permanently connected with the two transmitters so that a signal from any one will be recorded by the other two.

On the front of each station is a dial, identically marked, and a single hand. The synchro-tie so interconnects the stations that the movement of the pointer at any station will cause the other two to assume corresponding positions. Provisions are made so the units cannot be energized unless they are all in the same phase position. This insures the units being synchronized and also avoids the possibility of any unit running away. All three units have lights to indicate when the system is energized and ready for use.

Motor Operated Valve Controller With Relatrol Action

The demand for furnace temperature control with minimum disturbances to furnace atmosphere has resulted in development by Automatic Temperature Control Co. Inc., Philadelphia, of two new types of multi-position controllers known as the "Relatrol" and the "Balancer." Both units produce a corrective movement in a valve or damper in exact relation to departure from the temperature setting, as measured by the actuating instrument. This corrective movement follows the temperature changes so accurately and promptly that it may be said to be "tied to the temperature." In external appearance both units are alike. A special relay is supplied, wired into the circuit between the actuating instrument and the motor mechanism. This relay embodies an electrically controller nullpoint, and as full line voltage is used in both relay and power motor, extra responsiveness is secured to repositioning demand. The mechanism is housed in a sturdy, compact, cast iron case which will withstand the rough usage of industrial service.

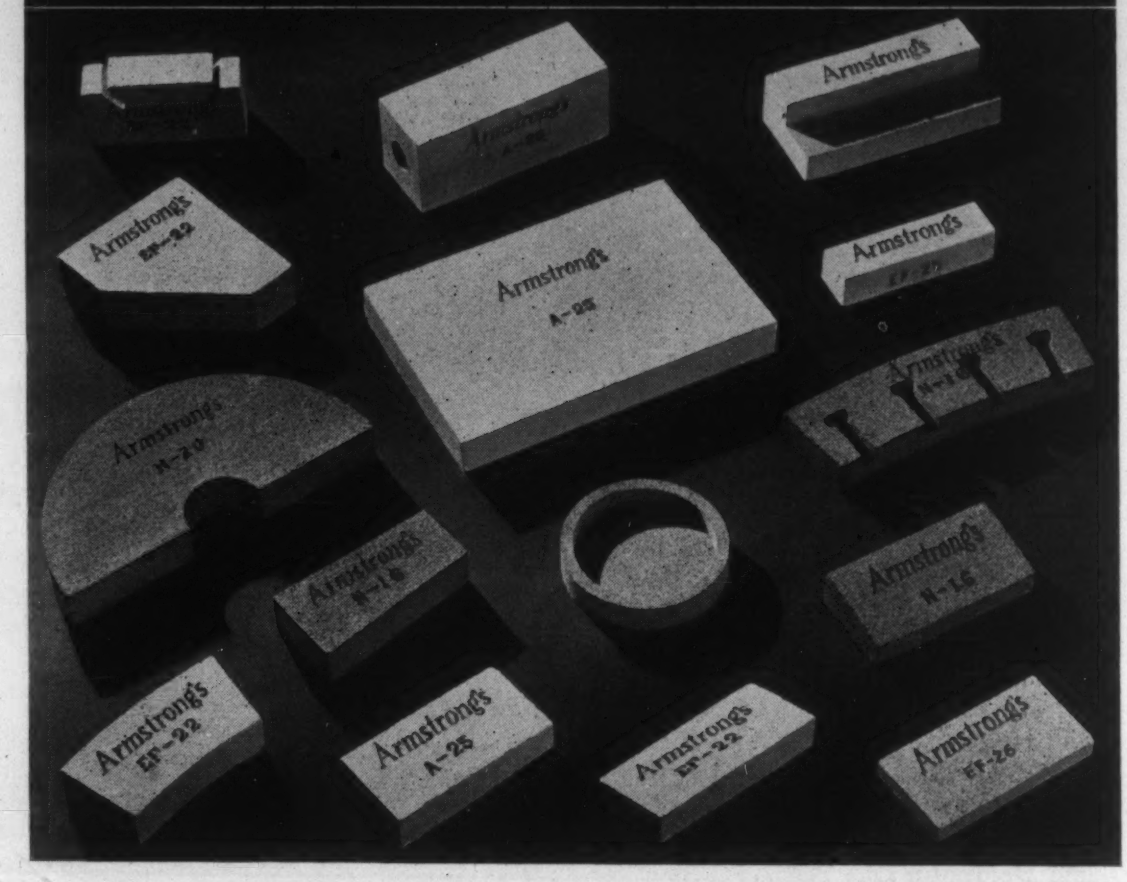


The Balancer is similar to the Relatrol except that it is provided with automatic means of load compensation and is recommended where load changes will be of considerable extent and duration. The new Relatrol action employed by these mechanisms can be used in conjunction with many standard pyrometers, flow meters and other measuring instruments, by slightly modifying the contact mechanism. In certain instances the required instrument changes can be made in the field. Where Relatrol action is supplied for manual remote control, a hand operated index and dial replaces the actuating instrument.

Haynes Stellite Valves

The Haynes Stellite Co., Kokomo, Ind., announces the publication of a new 8-page booklet "Haynes Stellited Valves." Increased life and economy resulting from the application of Haynes Stellite to the seating surfaces of valves for use in high temperature, high pressure steam service are fully described.

ALL SPECIAL SHAPES



. . . are available in Armstrong's

HIGH TEMPERATURE INSULATION

YOU can get any special shapes you need, in sizes up to 12" x 24" x 4½", both in Armstrong's Insulating Brick and Armstrong's Insulating Fire Brick.

Armstrong also manufactures and stocks a complete line of standard shape brick, as straights; splits; soaps; wedge, key, and arch bricks. All these bricks are available for a complete range of temperatures and uses.

For use behind the refractory, Armstrong offers N-16 Insulating Brick, highly efficient where the temperature does not exceed 1600° F.; N-20 Insulating Brick—a brick which will not crack, fuse, or spall under temperatures as high as 2000° F.; and A-25 Insulating Brick, for temperatures up to 2500° F.

For direct exposure where flame impingement or slagging action is not encountered, Armstrong makes EF-22, an Insulating Fire Brick efficient up to 2200° F.; and EF-26 Insulating Fire Brick, for temperatures up to 2600° F. Ask for a copy of the new folder of facts "Armstrong's High Temperature Insulation . . ." Armstrong Cork Products Co., Building Materials Division, 982 Concord Street, Lancaster, Pa.

Armstrong's

HIGH TEMPERATURE INSULATION

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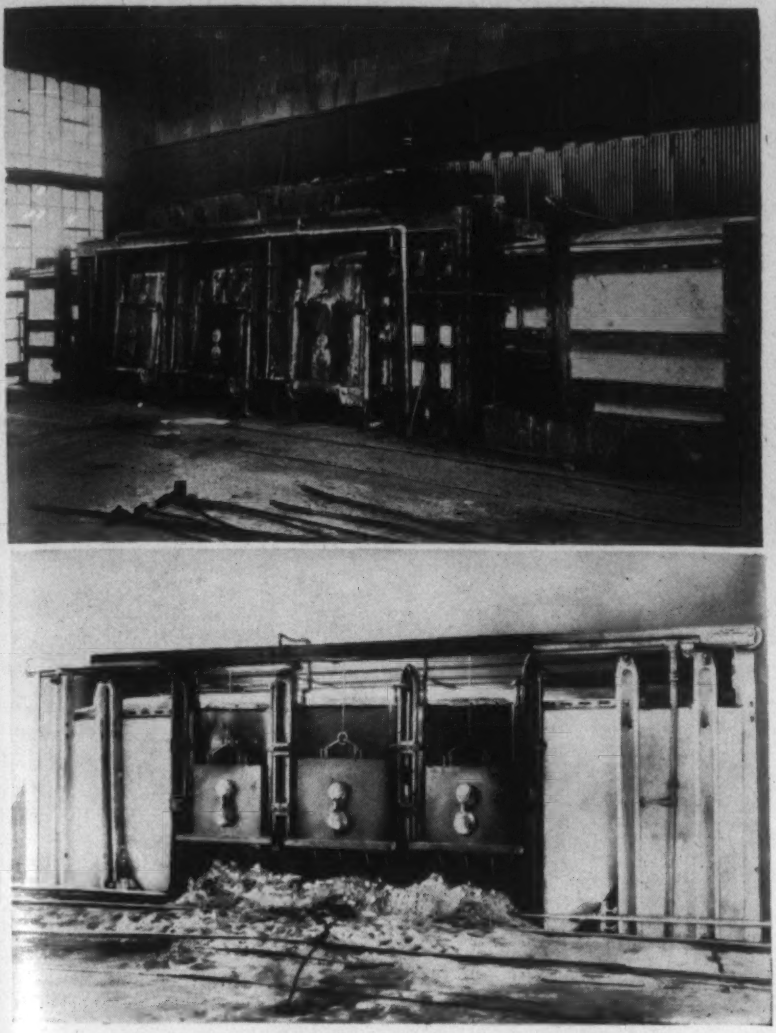
Wilson Mechanical Instrument Company, Inc. ..... MA 140

Youngstown Sheet and Tube Company ..... A 13



OPEN HEARTH FURNACES INSULATED

WITH SONITTEP INSULATION CEMENT

SAVE 10% TO 30% OF OIL CONSUMPTION

INCREASE REFRACTORY LIFE 5% TO 15%

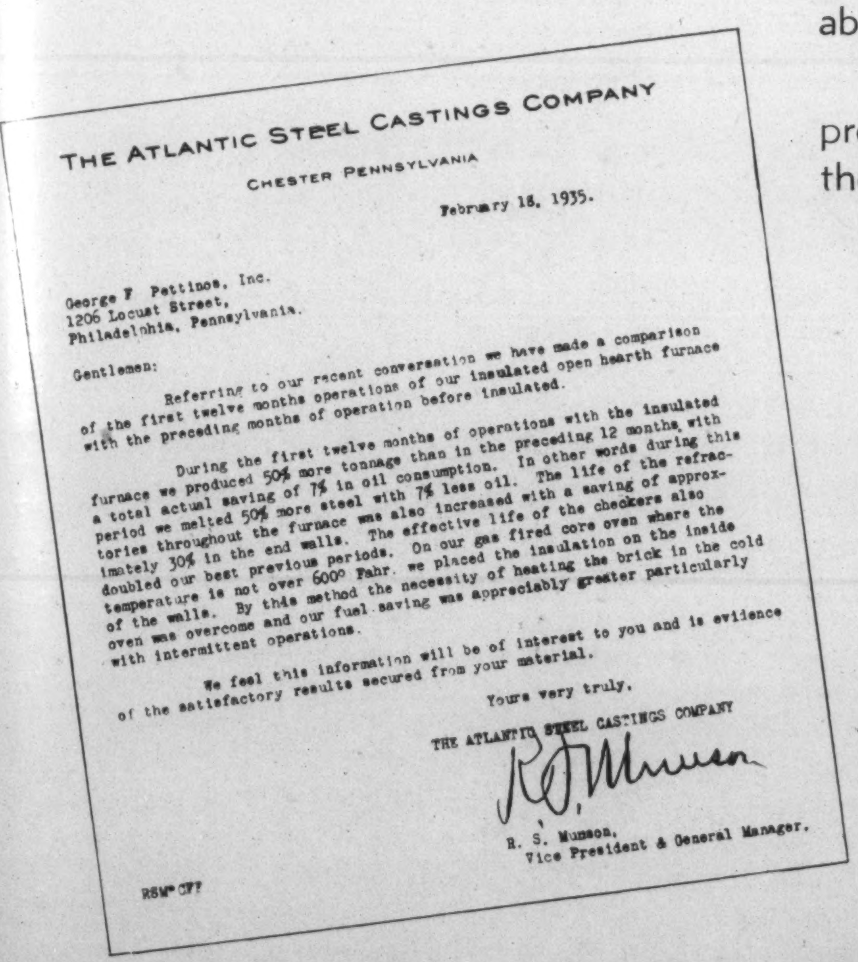
INSULATION should be judged by the work it does and not by the amount of sales talk about it.

Results of proper insulation will not only prove large fuel savings, but will also increase the life of the refractories.

Some of the advantages of

SONITTEP INSULATION CEMENT
are:—

1. **Requires no reinforcement.**
2. **Withstands temperatures up to 2,000°F. and over.**
3. **Stops air infiltration.**
4. **Sticks to hot or cold surfaces.**
5. **Unskilled labor can apply it.**
6. **Does not crack, shrink or peel.**



THE ATLANTIC STEEL CASTINGS COMPANY
CHESTER PENNSYLVANIA

February 18, 1935.

George F Pettinos, Inc.
1206 Locust Street,
Philadelphia, Pennsylvania.

Gentlemen:

Referring to our recent conversation we have made a comparison of the first twelve months operations of our insulated open hearth furnace with the preceding months of operation before insulated.

During the first twelve months of operations with the insulated furnace we produced 50% more tonnage than in the preceding 12 months, with a total actual saving of 7% in oil consumption. In other words during this period we melted 50% more steel with 7% less oil. The life of the refractories throughout the furnace was also increased with a saving of approximately 30% in the end walls. The effective life of the checkers also doubled our best previous periods. On our gas fired core oven where the temperature is not over 600° Fahr. we placed the insulation on the inside of the walls. By this method the necessity of heating the brick in the cold oven was overcome and our fuel saving was appreciably greater particularly with intermittent operations.

We feel this information will be of interest to you and is evidence of the satisfactory results secured from your material.

Yours very truly,

THE ATLANTIC STEEL CASTINGS COMPANY

R. S. Munson,
Vice President & General Manager.

RSM CFF

Before insulating your furnaces be sure to find out all of the advantages of insulating with

SONITTEP INSULATION CEMENT

GEORGE F. PETTINOS, Inc.
Philadelphia, Pa.
A cement for every purpose

American Foundrymen's Annual Convention in Detroit

THE 1936 annual convention of the American Foundrymen's Association will be held in Convention Hall, Detroit, the week of May 4 to 9. In connection with the convention there will be held the Foundry and Allied Industries Exposition. All indications point to the exposition being one of the largest ever held, presenting a great number of working exhibits, showing many new developments in foundry equipment and supplies. The tentative technical program shows a well balanced schedule of papers and reports on practical operating and metallurgical problems of all branches of the industry.

A Complete schedule of the sessions and events of the week is given on the following:

MONDAY, MAY 4

Registration—Convention Hall
Plant Visitation

TUESDAY, MAY 5

9:00 A.M. Registration—Conventional Hall

9:00 A.M. to 6:00 P.M. Exhibits Open—Convention Hall

9:00 A.M. Cast Iron Shop Course (Session 1)
Chairman: P. T. Bancroft, Moline, Ill.
Discussion Leader: E. J. Carmody, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.
Subject: *Cupola Operation and Repair*

10:00 A.M. Opening Meeting—Fortieth Annual Convention
Address of Welcome by Harvey Campbell, Detroit Board of Commerce.
Announcements.
President's Annual Address by D. M. Avey, Penton Publishing Co., Cleveland.

11:00 A.M. (a) Session on Nonferrous Casting Practice
Chairman, Jerome Strauss, Vanadium Corp. of America, Bridgeville, Pa.
Manganese Bronzes, by Dr. F. R. Hensel, P. R. Mallory Co., Indianapolis, Ind.
Pressure Castings in Aluminum Bronzes, by H. T. Ganzuage, Goulds Pumps, Inc., Seneca Falls, N. Y.
Annual Business Session—Nonferrous Division.
Report of Election of Officers.
Report of Committee on Recommended Procedure for the Analysis of Defects.

11:00 A.M. (b) Session on Malleable Cast Iron
Chairman, P. C. DeBruyne, Moline Malleable Iron Co., St. Charles, Ill.
Malleable Sand Control, by H. W. Dietert and F. Valtier, H. W. Dietert Co., Detroit.
Report of Committee on Specifications.

12:30 P.M. Luncheon and Round Table Discussion—Engineering Instructors.
Chairman, C. J. Freund, Dean of Engineering, University of Detroit, Detroit.

2:00 P.M. Session on Sand Reseabch
Chairman, R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston.
Vice Chairman, W. G. Reichert, Singer Mfg. Co., Elizabeth, N. J.
The Constitution of Bonding Clays and Its Influence on Bond Properties, by R. E. Grim, R. H. Bray, and W. F. Bradley, Illinois State Geological Survey, Urbana, Ill.
Deformation of Molding Sand, by H. W. Dietert and R. A. Dietert, H. W. Dietert Co., Detroit, Mich.
Practical Sand Control in Gray Iron Foundries, by H. Deane, Deere & Co., Moline, Ill.
Foundry Sand Testing Problems at High Temperatures, by P. E. Kyle, Massachusetts Institute of Technology, Boston, Mass.
Committee Reports.

4:00 P.M. Sand Control Shop Course (Session 1)

7:00 P.M. Joint Dinner and Smoker, Foundry Equipment Manufacturers Assn., A.F.A., and Detroit Chapter of A.F.A.

WEDNESDAY, MAY 6

9:00 A.M. to 6:00 P.M. Exhibits Open—Convention Hall.

9:00 A.M. Cast Iron Shop Course (Session 2)
Chairman, K. H. Priestley, Eaton-Erb Foundry Co., Vassar, Mich.
Discussion Leader, Fred J. Walls, International Nickel Co., New York.
Subject: *Fundamentals in Welding Cast Iron*

10:00 A.M. (a) Session on Cast Iron.
Chairman, M. Kuniansky, Lynchburg Foundry Co,, Lynchburg, Va.
Vice Chairman, V. A. Crosby, Climax Molybdenum Co., Detroit.
Control of Manganese in the Cupola, by M. T. Davis, III, General Electric Co., Ontario, Calif.
Determining the Height of Molten Metal in the Cupola, by Carl Harmon, Chevrolet Motor Co., Saginaw, Mich.
Effect of Coke Below Tuyeres, H. Johnson and James T. MacKenzie, by American Cast Iron Pipe Co., Birmingham, Ala.

(b) Session on Malleable Cast Iron
Chairman, F. L. Wolf, Ohio Brass Co., Mansfield, Ohio.
Vice Chairman, L. N. Shannon, Stockham Pipe Fittings Co., Birmingham, Ala.
Measuring and Controlling Pouring Temperatures, by C. F. Joseph, Saginaw Malleable Iron Div., General Motors Co., Saginaw, Mich.
Metallographic Chanages During Cooling Between First and Second Stages of Annealing, by H. A. Schwartz and C. H. Junge, National Malleable and Steel Castings Co., Clevelanad.
Selection of Melting Furnaces for Malleable Iron, by M. G. Girshovitch and H. F. Landa, Central Institute of Scientific Research for Machine Construction, U.S.S.R.

12:30 P.M. Luncheon and Round Table Discussion—Nonferrous Division
Chairman, T. C. Watts, Falcon Bronze Co., Youngstown, Ohio.
Vice Chairmen: H. J. Rowe, Aluminum Co. of America, Cleveland; Harold J. Roast, Canadian Bronze Co., Montreal, P. Q.
Topics for Discussion:

1. Melting Practice
   (a) Furnace Atmosphere
   (b) Furnace Operation
2. Insulation of Furnaces
3. Relation between Deoxidizer Content, Gates, Risers, Pouring Temperature, Shrinkage, and Sand Attack.
4. Questions on Papers read at Convention, on:
   (a) Aluminum Bronze
   (b) Silicon Bronze
   (c) Manganese Bronze
5. Cast Metals Handbook—How can it be made more helpful?

2:00 P.M. Session on Apprentice Training
Chairman, C. J. Freund, Dean of Engineering, University of Detroit.
Foundry Apprentice Training, by Franklin R. Hoadle ,
Farrel-Birmingham Co., Ansonia, Conn.
Apprentice Training in Detroit Industries, by H. W. Boulton, Murray Corp., Detroit.
Training Foundry Apprentices in Cleveland, by J. R. Goldie, Cleveland Vocational School, Cleveland.

3:30 P.M. Meeting of A.F.A. Cost Committee.

4:00 P.M. Sand Control Shop Course (Session 2)

8:00 P.M. (a) Session on Foundry Refractories:
Chairman, C. E. Bales, Ironton Fire Brick Co., Ironton, Ohio.
Vice Chairman, A. H. Dierker, Engineering Experiment Station, Ohio State University, Columbus, Ohio.
Behavior of Cupola Refractories Under Severe Operating Conditions, J. L. Lowe, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich.
Notes on Some Foundry Refractories, J. D. Sullivan, Battelle Memorial Institute, Columbus, Ohio.
Overcoming Spout Trouble by Use of a Monolithic Refractory Tile Trough, J. A. Bowers, American Cast Iron Pipe Co., and Charles Green, Alabama Clay Products Co., Birmingham, Ala.
Open Forum—Insulated Ladles.
Question Box:
(1) Is it possible to reduce silicon from sandstone used in the melting zone of a cupola?
(2) Is it possible to reduce titanium from blocks used in the melting zone of a cupola?
(3) Do fire clay shapes give better service than silica brick in some electric furnace roofs?
(4) Which is best, a fire brick bottom or a silica sand bottom, in malleable iron furnaces?
(5) What is the best type of refractory for the rotary, powdered-coal-fired type of furnace?

(b) Session on Steel Founding
Chairman, John Howe Hall, Taylor Wharton Iron & Steel Co., High Bridge, N. J.
Cleaning Steel Castings, Paul Dougher, American Steel Foundries, East Chicago, Ind.
Report of Committee on Test Coupons.
Report of Committee on Radiography.
Report of Representative on A.S.T.M. Committee on Specifications.

THURSDAY, MAY 7

9:00 A.M. to 6:00 P.M. Exhibits Open—Convention Hall.

9:00 A.M. Cast Iron Shop Course (Session 3)
Chairman, Leslie J. Korte, Atlas Foundry Co., Detroit.
Discussion Leader, G. P. Phillips, International Harvester Co., Chicago.
Subject: *Alloys—Why Used and What They Do to Cast Iron.*

10:00 A.M. (a) Session on Cast Iron.
Chairman, Dr. James T. MacKenzie, American Cast Iron Pipe Co., Birmingham, Ala.
Vice Chairman, E. K. Smith, Electro Metallurgical Co., Detroit.
Notes on Fatigue Properties of Alloy Cast Iron, by H. L. Daasch, Iowa State College, Ames, Iowa.
Heat-Treated Cast Iron, by M. Ballav and R. Chavy, Paris, France. Exchange Paper of the French Foundry Technical Assn.
Heat Treatment by Hardening and Tempering, by J. E. Hurst, President, Institute of British Foundrymen.

Exchange Paper of the Institute of British Foundrymen.
(b) Session on Nonferrous Castings
Chairman, H. M. St. John, Detroit Lubricator Co., Detroit.
Vice Chairman, T. E. Kihlgren, International Nickel Co., Bayonne, N. J.
Sand Castings of the Copper Silicon Alloys, by H. A. Bedworth and V. P. Weaver, American Brass Co., Waterbury, Conn.
Founding Aluminum Bronzes, by J. E. Crown, Naval Gun Factory, Washington, D. C.
Report of Committee on Recommended Practices.

12:30 P.M. (a) Luncheon and Round Table Discussion—Steel Division.
Chairman, A. H. Jameson, Malleable Iron Fittings Co., Branford, Conn.
(b) Luncheon and Round Table Discussion—Malleable Division.
Chairman, R. J. Teetor, Cadillac Malleable Iron Co., Cadillac, Mich.

3:30 P.M. Annual Business Meeting.

4:00 P.M. Sand Control Shop Course (Session 3)

7:00 P.M. A.F.A. Annual Dinner.

FRIDAY, MAY 8

9:00 A.M. Cast Iron Shop Course (Session 4)

9:00 A.M. to 6:00 P.M. Exhibits Open—Convention Hall.
Chairman, John Grennan, University of Michigan, Ann Arbor, Mich.
Discussion Leader, James H. Lansing, Kelsey Hayes Wheel Co., Detroit.
Subject: *Use of Pulverized Coal-Fired Rotary Furnace in Melting Cast Iron.*

10:00 A.M. (a) Session on Steel Founding.
Chairman, Major R. A. Bull, consultant on steel foundry practice, Chicago.
Vice Chairman; Marshall Post, Birdsboro Steel Foundry Co., Birdsboro, Pa.
Free and Hindered Contraction of Alloy Steel Castings, by C. W. Briggs and R. A. Gezelius, Naval Research Laboratory, Washington, D. C.
Report of Committee on Methods of Manufacture of Liquid Steel for Castings.
Report of Representative on Committee on Foundry Sand Research.

10:00 A.M. (b) Session on Cast Iron.
Chairman, H. Bornstein, Deere & Co., Moline, Ill.
Vice Chairman, A. L. Boegehold, General Motors Corp., Detroit.
Copper and Copper Manganese in Cast Iron, L. W. Eastwood, C. T. Eddy and A. E. Bousu, Michigan School of Mines and Technology, Houghton, Mich.
Symposium on Alloy Cast Iron:
Report of Committee on Foundry Practice.
Report of Committee on Specific Applicatons.
Report of Committee on Heat Treatment.

2:00 P.M. Session on Progress of Medical, Legislative and Engineering Aspects of Safety and Hygiene in the Foundry.
Chairman, D. M. Avey, president, A.F.A.
Medical Aspects:
Dr. R. R. Jones, Past Assistant Surgeon, Division of Labor Standards, U. S. Dept. of Labor, Washington, D. C.
Legislative Aspects:
Voyta Wrabetz, Chairman, Industrial Commission of Wisconsin.
Open Forum:
Forum Leader: Dr. J. A. Britten, Chief Surgeon, International Harvester Co., Chicago, Ill.

SATURDAY, MAY 9

9:00 A.M. Exhibits Open—DETROIT DAY.

4:00 P.M. Exhibits Close.

Awards for 1936 to David McLain and Dr. H. Ries

THE board of directors of the American Foundrymen's Association announces that, acting on the recommendation of its board of awards, it is granting the Joseph S. Seaman Medal of the association to Dr. Heinrich Ries of Cornell University in recognition of his outstanding services to the foundry industry and to the association in the field of foundry sand research and control, and to David McLain it has awarded the J. H. Whiting Medal in recognition of his contributions to the foundry industry in stimulating better melting practices. The presentation of these medals will be made at the annual dinner of the Association held during the 1936 convention in Detroit.

These medals are major awards of the association and are two of four gold medals which are given for distinguished service to the industry. They were made possible by funds donated in 1920 for this purpose by four past officers of the Association—charter members and prominent in fostering the association in its earlier development. These donors were: Joseph S. Seaman, the third president; J. H. Whiting, a past vice president, and founder of the Whiting Corp., Harvey, Ill.; William H. McFadden, tenth president, and John A. Penton, first secretary of A.F.A. and chairman of the board, Penton Publishing Co., Cleveland, Ohio.

Tentative List of Exhibitors

A FINAL list of the exhibitors was not available at the time of going to press but a partial list is published herewith. It may be stated that the prospects are for the best exhibition ever held by the A. F. A. with representation from many companies never before exhibiting at a foundry show. The representation of pig iron and alloy companies is reported by C. E. Hoyt, executive secretary, as the most complete on record.

Abrasive Co.	Philadelphia, Pa.
Ajax Electric Furnace Co.	Philadelphia, Pa.
Ajax Electrothermic Corp.	Trenton, N. J.
Ajax Metal Co.	Philadelphia, Pa.
Albany Sand & Supply Co.	Albany, N. Y.
Alpha-Lux Co., Inc.	New York, N. Y.
American Air Filter Co., Inc.	Louisville, Ky.
American Brake Shoe & Foundry Co.	Chicago, Ill.
American Bridge Co.	Pittsburgh, Pa.
American Crucible Co.	Shelton, Conn.
American Foundry Equipment Co.	Mishawaka, Ind.
American Gum Products Co.	New York, N. Y.
American Metal Market	New York, N. Y.
American Sheet & Tin Plate Co.	Pittsburgh, Pa.
American Steel & Wire Co.	Pittsburgh, Pa.
Arcade Mfg. Co.	Freeport, Ill.
Armstrong Blum Mfg. Co.	Chicago, Ill.
Automatic Transportation Co.	Chicago, Ill.
Ayers Mineral Co.	Zanesville, Ohio

C. O. Bartlett & Snow Co.	Cleveland, Ohio
Beardsley & Piper Co.	Chicago, Ill.
Bethlehem Steel Co.	Bethlehem, Pa.
Black & Decker Mfg. Co.	Towson, Md.
Blaw-Knox Co.	Pittsburgh, Pa.
Boyer-Campbell Co.	Detroit, Mich.
Bradley Washfountain Co.	Milwaukee, Wis.

Campbell-Hausfeld Co.	Harrison, Ohio
Carborundum Co., Abrasive Division	Niagara Falls, N. Y.
Carborundum Co., Refractory Division	Perth Amboy, N. J.
Edwin S. Carman, Inc.	Cleveland, Ohio
Carnegie-Illinois Steel Corp.	Chicago, Ill.
Certified Core Oil & Mfg. Co.	Chicago, Ill.
Chain Belt Co.	Milwaukee, Wis.
Champion Foundry & Machine Co.	Chicago, Ill.
Chateaugay Ore & Iron Co.	New York, N. Y.
Chicago Mfg. & Distributing Co.	Chicago, Ill.
Clark Tructractor Co.	Battle Creek, Mich.
Clearfield Machine Co.	Clearfield, Pa.
Cleveland Flux Co.	Cleveland, Ohio
Cleveland Quarries Co.	Cleveland, Ohio
Climax Molybdenum Co.	New York, N. Y.
L. A. Cohn & Bro., Inc.	Chicago, Ill.
Columbia Steel Co.	San Francisco, Calif.
Corn Products Sales Co.	New York, N. Y.
Cyclone Fence Co.	Pittsburgh, Pa.

Wm. Demmler & Bros.	Kewanee, Ill.
Detroit Electric Furnace Co.	Detroit, Mich.
Detroit Hoist & Machine Co.	Detroit, Mich.
Harry W. Dietert Co.	Detroit, Mich.
Joseph Dixon Crucible Co.	Jersey City, N. J.
Domhof & Joyce Co.	Cincinnati, Ohio

Eastern Clay Products, Inc.	Detroit, Mich.
Eaton-Erb Foundry Co.	Detroit, Mich.
Economy Tool & Machine Co.	Muskegon Heights, Mich.
Electro-Chemical Pattern & Mfg. Co.	Detroit, Mich.
Electro Metallurgical Co.	New York, N. Y.
Electro Refractories & Alloys Corp.	Buffalo, N. Y.

Fanner Mfg. Co.	Cleveland, Ohio
Federal Foundry Supply Co.	Cleveland, Ohio
Federated Metals Corp.	Chicago, Ill.
The Foundry	Cleveland, Ohio
Foundry Equipment Co.	Cleveland, Ohio
Foundry Supplies Mfg. Co.	Chicago, Ill.
Foxboro	Foxboro, Mass.

Globe Steel Abrasive Co.	Mansfield, Ohio
Great Lakes Foundry Sand Co.	Detroit, Mich.
Grindle Fuel Equipment Co.	Harvey, Ill.
Grob Brothers	West Allis, Wis.

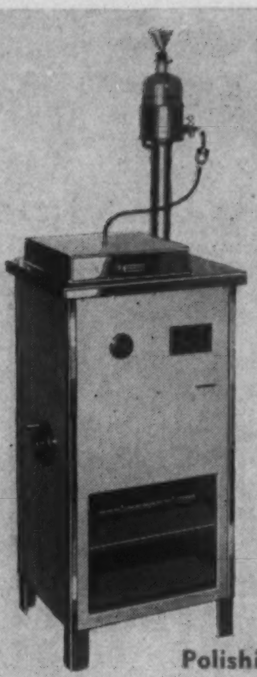
Hauck Mfg. Co.	Brooklyn, N. Y.
Herman Pneumatic Machine Co.	Pittsburgh, Pa.
Hickman, Williams & Co., Inc.	Chicago, Ill.
Hill & Griffith Co.	Cincinnati, Ohio
Hines Mfg. Co.	Cleveland, Ohio
Hougland & Hardy Co.	Evansville, Ind.

Illinois Clay Products Co.	Joliet, Ill.
Illinois Testing Laboratories, Inc.	Chicago, Ill.
Industrial Equipment Co.	Minster, Ohio
Industrial Minerals Co.	Lancaster, Ohio
Industrial Silica Corp.	Youngstown, Ohio
Ingersoll-Rand Co.	Phillipsburg, N. J.
International Molding Machine Co.	Chicago, Ill.
International Nickel Co., Inc.	New York, N. Y.
The Iron Age	New York, N. Y.
Ironton Fire Brick Co.	Ironton, Ohio

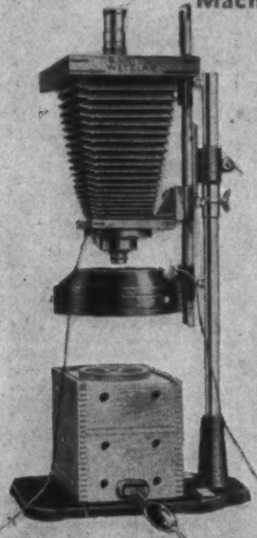
Jeffrey Mfg. Co.	Columbus, Ohio
Johnston & Jennings Co.	Cleveland, Ohio

*Keener Sand & Clay Co.	Columbus, Ohio
Kindt-Collins Co.	Cleveland, Ohio
H. Kramer & Co.	Chicago, Ill.

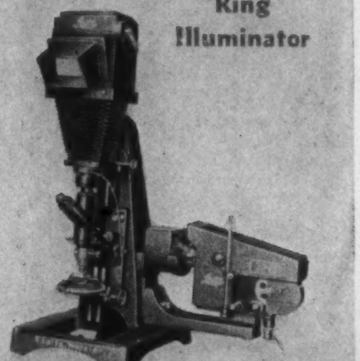
(Continued on page MA212)



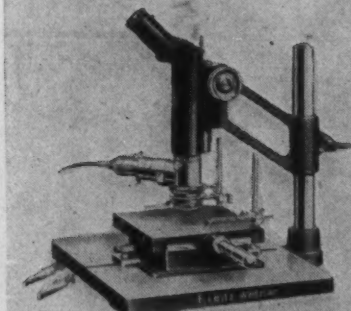
Polishing Machine



Ring Illuminator



Panphot



Measuring Microscope

VISIT OUR BOOTH at the

FOUNDRY and ALLIED INDUSTRIES EXPOSITION

Detroit, Michigan, May 4-9

We shall display many new instruments of special interest to everybody connected with the metal industries:

Polishing Machines:

A New Model of the "Guthrie-Leitz" Polishing Machine with greatly improved specimen holder, variable speed motor and other new improved features.

Photomicrographic Equipment:

1. Simple Photomicrographic Apparatus MA-111 with special new large Ring Illuminator for photography of large objects.
2. Leitz PANPHOT, the most universal microscope with camera for every conceivable purpose of microscopy and photomicrography;

Metal Microscopes:

1. New models of high precision Measuring Microscopes for control purposes, of special interest to tool makers and production engineers.
2. Large and small Micro-Metallograph, equipments for observation in darkfield and polarized light;
3. Simple, inexpensive Metal Microscopes with Photomicrographic Camera Attachments;

Dilatometers:

Leitz New Simplified Dilatometer, an instrument of highest precision, recording automatically and photographically temperature-expansion curves. Many attachments for special purposes.

We shall also display many new accessories including a complete line of LEICA cameras and Auxiliary Devices.

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60 East 10th Street **New York, N. Y.**

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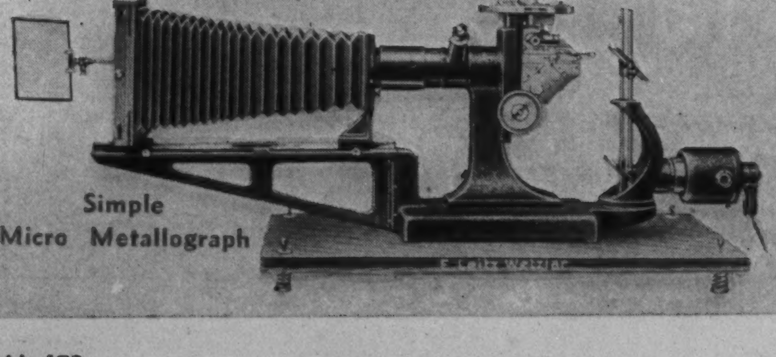
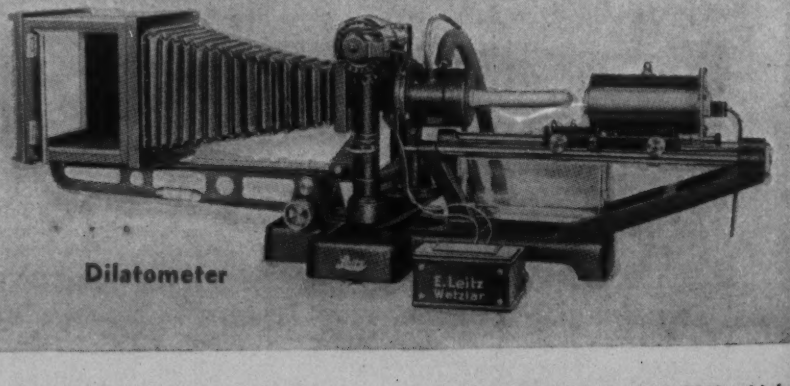


Simple Micro Metallograph



Dilatometer

CURRENT

Metallurgical Abstracts

A Digest of the Important Metallurgical Developments of the World

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CLASSIFICATIONS

ORE CONCENTRATION (1)

Crushing, Grinding & Plant Handling (1a)
Gravity Concentration (1b)
Flotation (1c)
Magnetic Separation (1d)
Amalgamation, Cyanidation & Leaching (1e)

ORE REDUCTION (2)

Non-Ferrous (2a)
Ferrous (2b)

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Non-Ferrous (3a)
Ferrous (3b)

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Forging & Extruding (4b)
Cold Working, including Shearing, Punching, Drawing & Stamping (4c)
Machining (4d)

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Malleableizing (5d)
Carburizing (5e)
Nitriding (5f)

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JOINING (7)

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Welding & Cutting (7b)
Riveting (7c)

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Polishing & Grinding (8c)
Electroplating (8d)
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Non-Metallic Coatings (8f)

TESTING (9)

Inspection & Defects, including X-Ray Inspection (9a)
Physical & Mechanical Testing (9b)
Fatigue Testing (9c)
Magnetic Testing (9d)
Spectrography (9e)

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PROPERTIES OF METALS AND ALLOYS (11)

Non-Ferrous (11a)
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EFFECT OF TEMPERATURE ON METALS AND ALLOYS (12)

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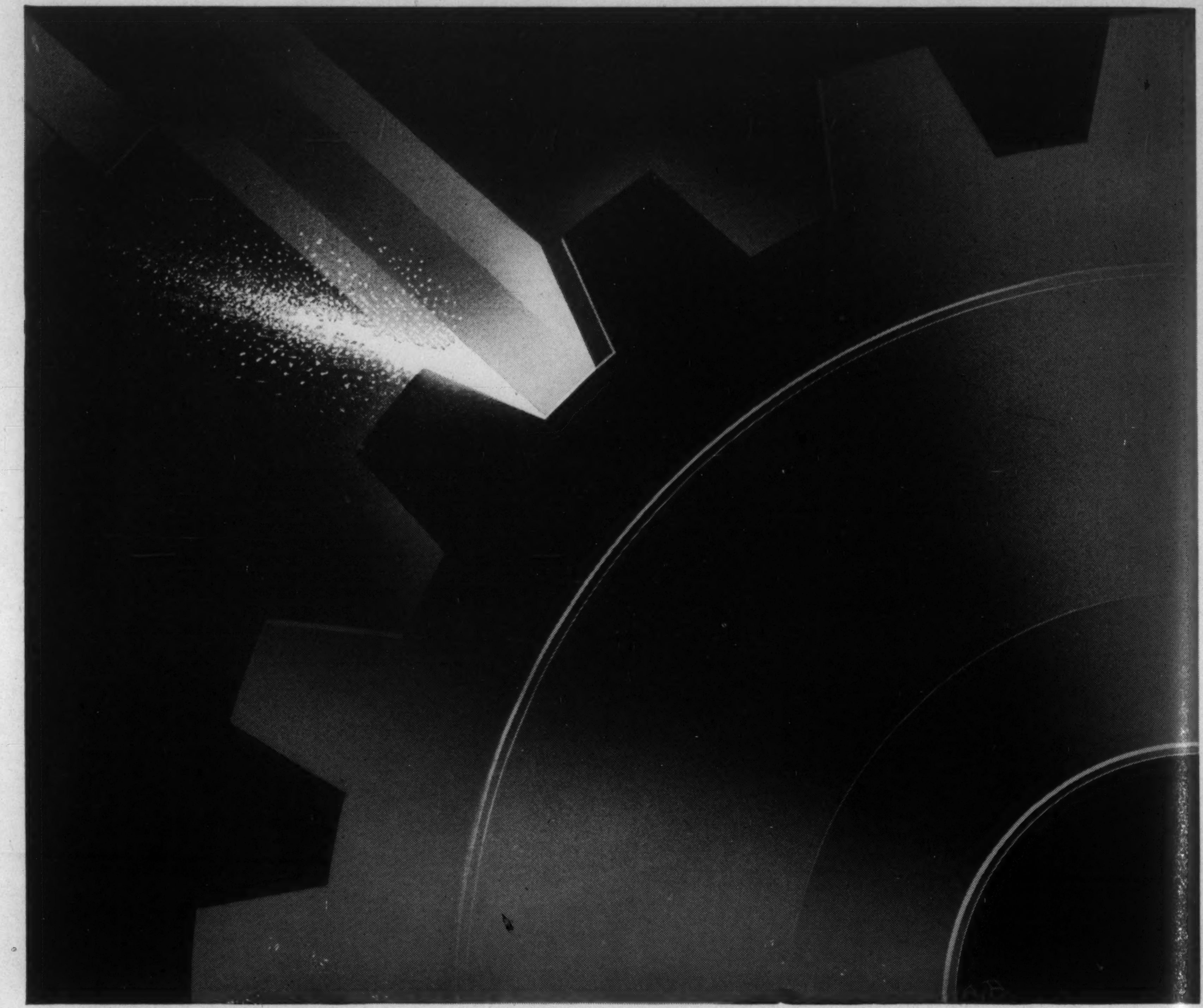

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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Significance of Ore Dressing with Reference to the German Metallurgical Raw Material Situation (Die Bedeutung der Aufbereitung für die deutsche Metallrohstoffwirtschaft). W. Petersen. *Die Metallbörse,* Vol. 25, 1935, July 20, 1935, pages 913-914; July 27, 1935, pages 945-946; Aug. 3, 1935, pages 977-978; Aug. 10, 1935, pages 1009-1010. The occurrence of low grade ores in Germany and the possibility of their commercial utilization is fully considered with reference to Cu, Pb, Zn, Cd, Sn, steel alloying elements, Bi, Hg, Sb, As, U, noble and light metals. EF (1)

Silver and Silver-Pitchblende Ore from Bear Exploration and Radium, Limited, Great Bear Lake, N.W.T. W. B. Timm *et al. Canada Department of Mines, Mines Branch Report* No. 747, 1935, pages 30-43. About 90% of the Ag can be concentrated by tabling and flotation or blanket concentration and flotation, but the tailings carried 100-200 oz. Ag/ton that can be recovered only by chemical treatment. Amalgamation recovered 91.5-93.7% of the Ag; flotation recovered only 27% of the Ag in the tailings and left a 100 oz. tailing. Cyanide extraction is high, but cyanide consumption is excessive. Tabling recovered 54.7% of the pitchblende in a concentrate containing 39.09% pitchblende, but leaving a 3.56% tailing. Flotation showed little concentration. AHE (1)

1c. Flotation

Mechanism of Flotation. IV. Oriented Coagulation in Unpolar and Aqueous Media (Zur Frage des Mechanismus der Flotation. IV. Die orientierende Koagulation in unpolarem und wässerigem Mittel). Z. W. Wolkawa. *Kolloid Zeitschrift,* Vol. 72, Aug. 1935, pages 229-233. Formation of mineralized air emulsion in the flotation of fine and coarse powder is interpreted as a process of oriented coagulation of powder particles at the interfaces of the participating phases. EF (1c)

Mechanism of Flotation. The Role of Highly Disperse Powders in the Flotation Process. (Zur Frage des Mechanismus der Flotation. Die Rolle der hochdispersen Pulver im Prozess der Flotation). Z. W. Wolkowa & A. W. Saporoshez. *Kolloid Zeitschrift,* Vol. 72, July 1935, pages 82-86. Flotation of some highly disperse powders in i-amyl-alcohol solutions of low concentrations is reported. No adsorption of the reagent or coagulation of particles could be observed. EF (1c)

Gold Ore from the Brussières Mining Company, Limited, Senneterre, Que. W. B. Timm *et al. Canada Department of Mines, Mines Branch Report* No. 747, 1935, pages 204-207. The classifier overflow passed over corduroy blankets to flotation. Cu was floated by 0.05 lb. cresylic acid/ton. The tailings yielded a pyrite concentrate by flotation using 0.15 lb. amyl xanthate. AHE (1c)

Further Tests in Flotation of Free Gold—Effect of Amyl Xanthate and Pulp pH on Recovery is Studied. Acid Wash to Remove Chemical Films Has Beneficial Result. Tests Should be Run with Checks. John W. Johns. *Engineering & Mining Journal,* Vol. 136, Oct. 1935, pages 498-499. Results are shown of a series of flotation tests showing the effect of an amyl xanthate and the pH of the pulp on the recovery of placer Au. Very low Au recovery resulted when potassium-amyl-xanthate and terpineol were used alone, but marked improvement was evident when the pH was kept between 7.7 and 8.2, by additions of H_2SO_4 or NaOH as required. WHB (1c)

1d. Magnetic Separation

Magnetic Ore Separator. *Engineering,* Vol. 140, Sept. 20, 1935, pages 305-306. Briefly describes a machine manufactured by Messrs. Electromagnets, Limited, Birmingham. It is suitable for use with materials which are only slightly magnetic such as the ores of wolfram, monazite, magnetite, ilmenite and zircon. They may be extracted together as their varying degrees of magnetic properties will lead to their separation. LFM (1d)

1e. Amalgamation, Cyanidation & Leaching

Tailings Treatment at Yellow Aster Successfully Under Way. Walter Lyman Brown. *Engineering & Mining Journal,* Vol. 136, Dec. 1935, pages 597-599. The Anglo-American Mining Corp., Ltd., has completed a cyanide plant for tailing treatment of rated capacity of 1125 tons per day which is designed for labor economy and a high degree of automatic operation. The surface layout and a flowsheet are shown. WHB (1e)

Historical Notes on the Patio Process. T. A. Rickard. *Transactions Canadian Institute of Mining & Metallurgy,* 1936 (in *Canadian Mining & Metallurgical Bulletin* No. 285, Jan.) pages 23-48. NaCl, $CuSO_4$ and Hg are added at widely separated intervals to Ag ore; the whole process takes 24 to 30 days. Ag extraction is 80-85%. AHE (1e)

The San Antonio Mine and Mill. *Transactions Canadian Institute of Mining & Metallurgy,* 1936 (in *Canadian Mining & Metallurgical Bulletin* No. 285, Jan.) pages 1-9. The cyanide mill is described. AHE (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

2a. Non-Ferrous

Mineralogy of Lead Slags (Zur Mineralogie der Bleischlacken) W. Faber. *Fortschritt der Mineralogie, Kristallographie & Petrographie,* Vol. 19, Sec. I, 1935, pages 24-30. Ten minerals were extracted by centrifuging slags from a Pb blast furnace. The analysis of the slag used for the smelting of certain refractory ores of the Hartz is as follows: 20-35% SiO_2; 8% Al_2O_3 max., 2% Fe_2O_3, 10-25% CaO, 30-40% FeO, 7% MgO max., 8-15% ZnO, 1% MnO, 0.5-1% Cu, 1-3% Pb, 2-5% sulphide S. EF (2a)

Comparison of Methods of Operating an Aluminum Electrolytic Cell. Ya. A. Bernshtein & G. I. Khvilivitzkii. *Legkie Metallui,* Vol. 4, Apr. 1935, pages 16-23. In Russian. The cell was operated under conditions of constant current, voltage, or power input respectively. The output per day and the consumption of electrical energy per kg. of Al were greatest when the current was kept constant and least when the voltage was constant. The results were: constant current, 149 kg. Al, 19.4 kw-hr.; constant voltage, 118 kg. Al, 17.5 kw-hr.; constant power imput, 138 kg. Al, 18.8 kw-hr. HWR (2a)

Notes on Copper Refinery Furnace Firing and Refractories. H. C. Robson. *Bulletin of the Institution of Mining & Metallurgy* No. 374, Nov. 1935, pages 1-15. Discussion. AHE (2a)

Beryllium (Le glucinium ou béryllium) *Génie Civil,* Vol. 107, Oct. 12, 1935, pages 347-348. General information on preparation, properties and statistics of Be production in Europe and America. JDG (2a)

Electrolytic Production of Boron and Its Alloys (La fabrication électrolytic du bore et de ses alliages) L. Andrieux. *Revue de Métallurgie,* Vol. 32, Oct. 1935, pages 487-493. Electrolysis of B can be conducted in a graphite crucible, serving as anode with a cooled Fe rod used as cathode. Electrolyte is composed of B_2O_3 to which are added oxides and fluorides of metals able to reduce B (the author prefers Mg). During the electrolysis of the molten mixture at around 1100° C., Mg concentrating around cathode reacts with the bath forming Mg borate, which is more basic and less fusible than the bath. It is deposited along with metallic B on the cathode. After removal and treating with HCl, the metallic deposit contains about 85% B. Electrolyzing borates with Ca, Ba, Sr, Ce and Mg halides, one obtains corresponding borides. Many B alloys can be prepared by using cathodes made of the metal in question and a bath able to supply B. The bath is heated to the temperature at which the metal remains solid but at which its eutectics with B are melted. Ni eutectic, for example, melts at 990° C. and Fe-B eutectic melts at 1174° C. B is deposited on the metal with which it alloys and as soon as the eutectic composition is reached it melts and accumulates in the bottom of the crucible. The composition of the alloys so produced depends within certain limits on the temperature and the duration of electrolysis. 20 references. JDG (2a)

2b. Ferrous

The Blast Furnace as a Chemical Plant. C. O. Bannister. *Blast Furnace & Steel Plant,* Vol. 23, Nov. 1935, pages 777-779, 795; Dec. 1935, pages 856-858. Paper read before the Society of Chemical Industry. See *Metals & Alloys,* Vol. 6, June 1935, page MA 221L/8. MS (2b)

Sintering of Ferro-Manganese Ores from Kemaman in Malay and Elimination of Lead and Zinc from them. Gaichi Yamada, Ryu Nakanishi & Yukimaro Nakahara. *Tetsu to Hagane,* Vol. 21, Nov. 25, 1935, pages 865-875. In Japanese. By sintering and volatilizing ferro-manganese ores from Kemaman in Malay, the following results were obtained: (1) In an oxidizing atmosphere the ores do not melt at 1250°; in a reducing atmosphere they melt at 1250° after heating with carbonaceous fuels; (2) the ores sinter well at 1200° with or without addition of carbonaceous fuels; (3) the elimination of Pb and Zn by volatilization and the strength of sintered ores increase as anthracite additions increase; (4) the elimination of Pb is easy, but that of Zn difficult; (5) on roasting at 1100° for 2 hours with addition of 5% anthracite the rates of eliminating Pb and Zn increase to 98.7% and 82.5%, respectively, and the contents of Pb and Zn in the sintered ores are 0.1% and 0.4%, respectively; (6) to eliminate Pb and Zn by volatilization, the ores should be roasted with addition of more than 5% powdered anthracite or coke in a long rotary kiln, in which the ores sinter at 1200°-1250° in an oxidizing atmosphere. TS (2b)

Investigations into the Solubility of Siderite and the Electrolytic Deposition of Iron from These Solutions (Versuche über die Löslichkeit von Siderit und über die elektrolytische Abscheidung des Eisens aus diesen Lösungen) R. Müller & L. Harant. *Berg- und Hüttenmännisches Jahrbuch,* Vol. 83, Nov. 20, 1935, pages 93-102. The practical possibilities of electrolytic Fe production are discussed. Two principal cases are distinguished: (1) Refining of raw Fe, which usually is anodically dissolved from plates of cast Fe and cathodically deposited in very pure form; (2) an electrolyte is obtained by direct action of solvents on the ore, and the pure Fe is deposited from this solution by electrolysis. The latter method is used in the processes of Estelle, Motham, Eustis and Perrin. Kangro and Linder have developed a new method by which the Fe in siderite is volatilized as $FeCl_2$ or $FeCl_3$ by chlorination roasting at 800°-1000° C.; almost all impurities such as Al_2O_3, CaO, SiO_2 and phosphate remain behind. Siderite is rather difficultly soluble in alkali and ammonium bicarbonate, $CaCl_2$, ammonium chloride, and CO_2 under pressure, in contrast to precipitated $FeCO_3$. Deposition from such solution is possible; the deposit was white and very bright but did not adhere to the cathode and collected at the bottom of the cell as $FeCO_3 + Fe(OH)_2$ slime. 25 references. Ha (2b)

3. MELTING, REFINING AND CASTING

Some Properties of Mold and Core Materials at Elevated Temperatures. FRANK HUDSON. *Foundry Trade Journal,* Vol. 53, Dec. 5, 1935, pages 411-416. Paper read before East Midlands Branch of the Institute of British Foundrymen. The effect of heat on the properties of mold and core materials such as permeability, expansion, strength is discussed. It was found that at 1000° C. the permeability of mold and core materials is greater than at room temperature. The increase in permeability is probably due to the expansion of the individual sand grains, in conjunction with the promotion of extra voids through the removal of gas forming elements. The degree of expansion varies according to the nature of the sand. The addition of materials such as coal dust, saw dust, etc., have a marked effect in reducing the degree of expansion. The greatest degree of expansion in all the sands investigated takes place between 500° and 700° C. and the total degree of expansion is of such magnitude as to warrant very serious consideration in the production of castings. The fact that the greatest degree of expansion takes place suddenly, between 500° and 700° C. may possibly lead to the production of defective castings. If during casting one part of the mold is heated to a higher temperature than another, the degree of expansion will vary and buckling of the mold surface may occur. A sand having as little expansion on heating as possible would be ideal. It was found that, with the exception of "iron foundry green sand" and "oil sand," the heat increases the strength of the sand to a marked degree. For instance, the dried compression strength of the "brass foundry green sand" is 133 lbs./in.,^{2} at room temperature, and this increases to a maximum of 1200 lbs./in.,^{2} at 900° C. Further increase in temperature causes the strength of the sand to drop rapidly to the low figure of 25 lbs./in.,^{2} at 1000° C. It may be found that the sands which expand most are also most subject to increase in strength at elevated temperatures. Such a combination is particularly dangerous, and must be responsible for a large percentage of defective castings in the average foundry. AIK (3)

Studies Green and Dry Strengths. H. N. ROSE. *Foundry,* Vol. 63, Oct. 1935, pages 28, 67-68, 70. Gives results of tests made on a number of naturally bonded sands using the American Foundrymen's Association methods. All tests were made at controlled moistures of 6, 8 and 10% ± 0.1% and comprised unmulled green tensile, compression, shear, dry tensile and compression strengths. Results show that a given temperature lowers green and dry strength, but decrease of dry strength was on an average 2 or 3 times that of green strength. Includes a table giving change in strengths resulting from mulling. VSP (3)

Foundries Aim at High Quality. *Steel,* Vol. 98, Jan. 6, 1936, pages 222, 224, 322-325. Summarizes opinions of various authorities regarding achievements of the foundry industry in 1935. MS (3)

3a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Porosity in Leaded Bronze Bushings. A. W. LORENZ. *Foundry Trade Journal,* Vol. 52, June 6, 1935, pages 377-378; *Die Metallbörse,* Vol. 24, Dec. 15, 1934, page 1595; *Metal Industry,* London, Vol. 46, June 7, 1935, pages 621-623. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 438R/5. AIK + EF + HBG (3a)

Some Practical Non-Ferrous Foundry Problems. F. DUNLEAVY. *Metal Industry,* London, Vol. 46, Mar. 29, 1935, pages 351-354; Apr. 12, 1935, pages 412-414; Apr. 26, 1935, pages 458-459. Paper read before the East Midlands Branch of the Institute of British Foundrymen on Feb. 16, 1935. After pointing out the necessity for close attention to detail of the practical man in the non-ferrous foundry, the author described several jobs all of which had been selected for discussion because knowledge other than that required for routine work was necessary to produce successful castings. The molding of these castings is described in detail to emphasize the difficulties that are encountered due to a lack of proper equipment and limited melting capacity. Factors requiring special consideration in casting bearings are venting, location and methods of feeding runners and casting temperature. Another problem was the necessity for a drastic change in the method of molding due to a change in the alloy specification. The small leeway in range of pouring temperature for thin and thick sections was an important factor. In the casting of small bearings the effect of pouring temperature is a major factor. In casting of Al alloys the author considers the following as essential; (1) sand must be rammed lightly over all faces, (2) sand must be used dry and well-vented, (3) care is necessary in placing runners, risers and chills, (4) the construction of all cores, and (5) casting temperature. Suggestions are offered concerning the cause of common defects found in Al castings. The difference in gating practice used for bronze and Al casting is illustrated in the author's description of the casting of an Al handwheel. Pinholes in Al castings are attributed to (1) overheating in the furnace and (2) casting at too high a temperature. HBG (3a)

Observations of the Porosity and Segregation of Two Bronze Ingots. N. P. ALLEN & S. M. PUDDEPHAT. *Metal Industry,* London, Vol. 47, Sept. 13, 1935, pages 269-271; discussion Sept. 20, 1935, pages 299-300. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 438R/4. HBG (3a)

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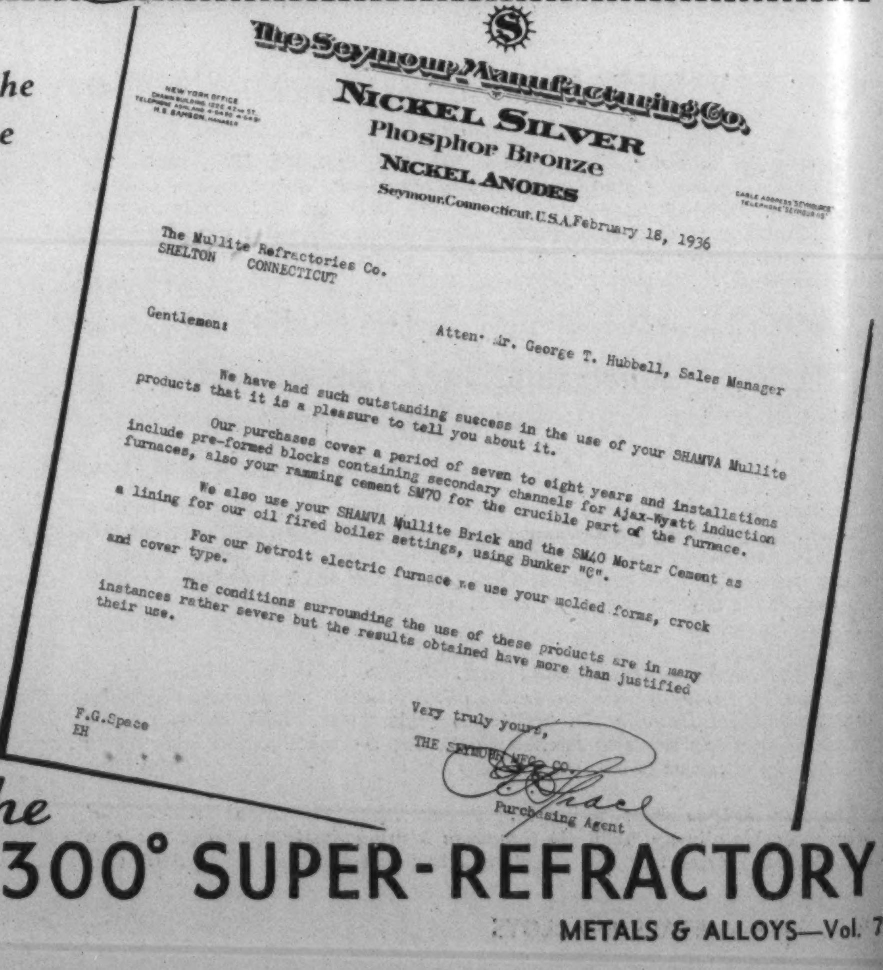

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Defects in the Manufacture of Silver Sheets (Mängel bei der Silberblechherstellung. III). E. Raub. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 9, Oct. 1935, pages 60-75. Deals with the effect of pouring temperature on the properties of Ag sheet rolled from test billets. The temperature at which Ag or a Ag rich alloy is poured is dependent on the type of mold (chill or sand), its capacity, shape and design and upon the composition of the metal. An empirical method is developed whereby proper temperatures can be estimated. Photographs showing typical casting defects are included. Ha + GLC (3a)

Non-Ferrous Casting Alloys. Symposium on Deoxidation and Degasification. III. Yellow Brass. L. A. Ward. **IV. The Use of Charcoal in the Non-Ferrous Foundry.** R. J. Keeley. *Metal Industry,* London, Vol. 46, May 31, 1935, pages 597-600. See *Metals & Alloys,* Vol. 6, Dec. 1935, pages MA 482R/6 and MA 484R/2. HBG (3a)

Problems of Sound Bronze Ingots. Problems of Deoxidation and Degasification. Edmund R. Thews. *Metal Industry,* London, Vol. 47, Oct. 25, 1935, pages 419-422. Author discusses in detail: (1) contamination of scrap, (2) preliminary melting, (3) influence of method of melting, (4) oxidation effects of fuel gases, (5) order of charging, (6) fluxes, and (7) methods of casting. It is indicated that production of a nonoxidized and dense material necessitates consideration of a number of important factors and that each factor, in itself, may ruin the product. HBG (3a)

Scrap Metal Preparation (Aus der Praxis der Altmetall-Aufbereitung) E. R. Thews. *Die Metallbörse,* Vol. 25, June 29, 1935, pages 818-819; July 6, 1935, pages 849-850; July 13, 1935, pages 881-882. Discusses exhaustively the use of fluxes and protective mixtures for use in melting and remelting of brass and brass scrap. EF (3a)

Casting Under Pressure (La Fonderie sous Pression Élevée). Ladislav Jenicek. *Bulletin de l'Association Technique de Fonderie,* Vol. 9, Sept. 1935, pages 294-300. Second part of a paper presented before the A. T. F., Apr. 27, 1935. Comparison of the physical properties of brass castings made in sand molds, in chills, and pressure cast. Intricate and thin walled castings are readily made by the use of high pressure machines. Details of hot and cold mold pressure casting and cost figures are given. 8 references. WHS (3a)

Small Aluminum Die-Castings Made in Machines of Simple Design. Chas O. Herb. *Machinery,* N. Y., Vol. 42, Dec. 1935, pages 244-247. Recommends careful control of holding pot and die temperature. Several features of dies are described; an irregular parting line in the die often offers advantages. Ha (3a)

Preheating Bearings for Lining with Babbitt. J. E. Hyler. *American Machinist,* Vol. 79, Dec. 18, 1935, page 915. The advantage of moderately preheating bearings before lining with babbitt, particularly in cold weather, is discussed. Ha (3a)

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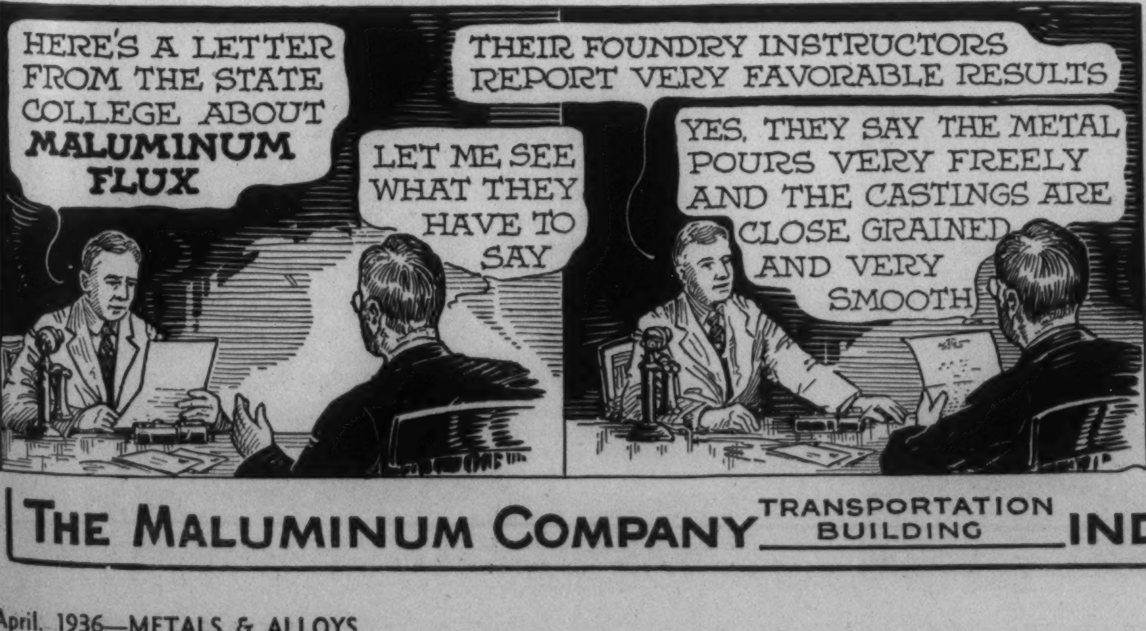
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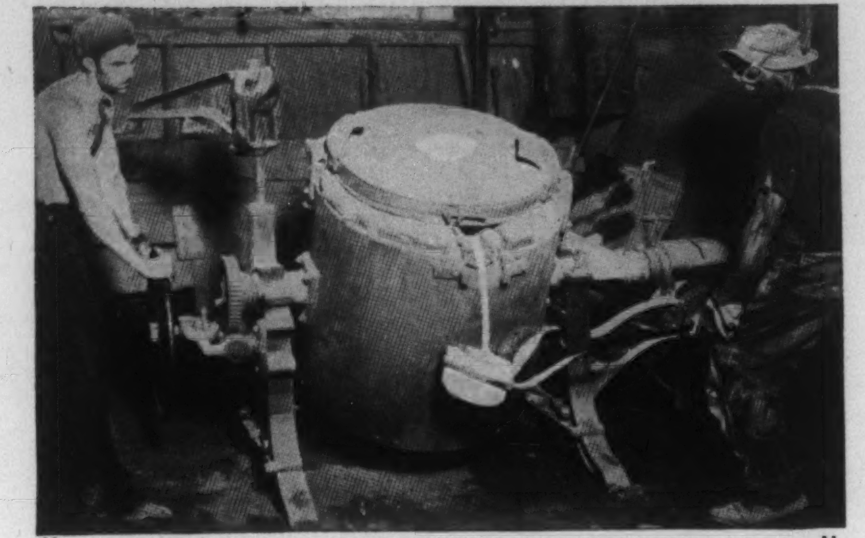

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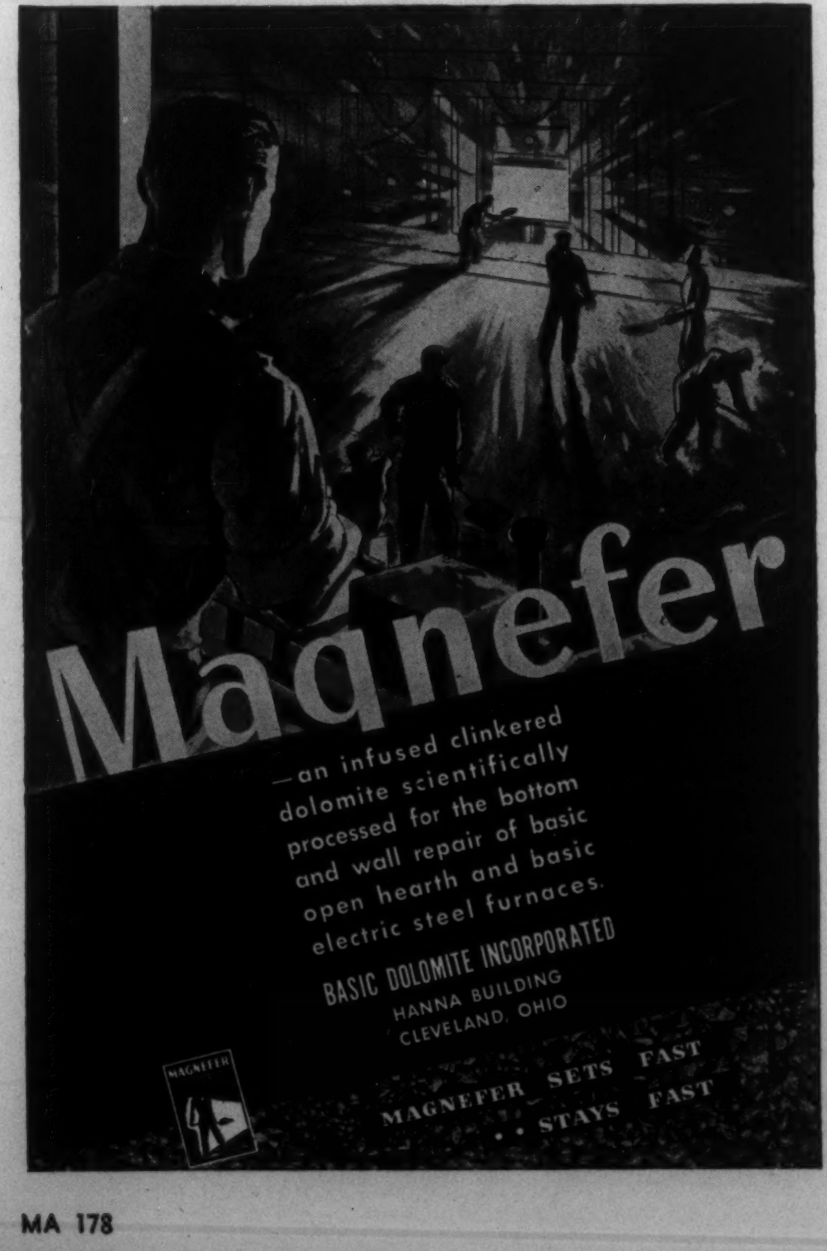

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Deoxidation and Degasification of Metals. Developments in Refining Methods. Henry Lepp. *Metal Industry,* London, Vol. 47, Sept. 27, 1935, pages 315-318; Oct. 4, 1935, pages 341-345. In a review of recent developments in methods of refining, the author discusses (1) the influence of gaseous impurities and, (2) effects of N, H, O and hydrocarbons. Solubility of a number of gases in alloys and the effect of these gases on the solidified metal are discussed. Deoxidation by means of additions of Mg, Al, Ca and by means of slags are considered. Reference is made to recent investigations on slag metal equilibria. The present day methods deemed as most practical are (1) presolidification, (2) reduction by H which is eliminated by an inert gas, (3) reduction by CO, (4) treatment with Cl or its volatile compounds, (5) melting in vacuo, and (6) gas elimination by oxidation. Selective oxidation is considered and the results obtained on treated and untreated alloys are compared. The elimination of S by additions of Mn, Mg, etc. is discussed. 103 references. HBG (3a)

Metal Losses in Melting Brass and Other Copper Alloys. Maurice Cook, *Engineer,* Vol. 160, Sept. 17, 1935, page 330; *Engineering,* Vol. 140, Sept. 20, 1935, pages 311-312; *Metal Industry,* London, Vol. 47, Sept. 13, 1935, pages 263-268; discussion, Sept. 20, 1935, pages 301-303. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 482R/7. HBG + LFM (3a)

Observations of the Porosity and Segregation of Two Bronze Ingots. N. P. Allen & S. M. Puddephat. *Engineering,* Vol. 140, Sept. 20, 1935, page 312. From a paper read before the Institute of Metals, Sept. 1935. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 438R/4. LFM (3a)

Producing a Large Lead Casting. F. J. McGrail. *Foundry,* Vol. 63, Sept. 1935, pages 26-29, 80, 86. Describes in detail method used in producing a Pb casting for an evaporator unit weighing about 35,000 lbs. Sb was added to Pb to make casting stronger. The composition of the metal was 92% Pb and 8% Sb. The casting was done by the Struthers-Wells-Titusville Corpn. VSP (3a)

Foundry Production of Nickel Silver. T. E. Kihlgren. *Metals & Alloys,* Vol. 6, June 1935, pages 139-143; July 1935, pages 175-180. Best foundry procedure may be summarized as follows: use pure raw materials of correct composition, melt rapidly under slightly oxidizing conditions, deoxidize with 0.10 Mn + 0.05 Mg + 0.02 P, pour at 2400°-2450° F., fill molds rapidly without excessive turbulence, use gates and risers 2-3 times as heavy as for red brass, vent molds and cores thoroughly and use fairly open sands and soft cores that collapse readily. Various laboratory and experimental foundry tests are described including development of best deoxidation procedure for pressure tight castings and for best tensile properties. Pouring temperature and melting pit temperature control are discussed. WLC (3a)

Furnace for the Electrolysis of Aluminum (Fours d'Electrolyse à Aluminium). Louis Ferrand. *Industrie Electrique,* Vol. 44, Oct. 10, 1935, pages 440-442. A new type of smelting furnace for Al is described which is closed to avoid the very large radiation losses of the usual open type furnaces. The anodes are so arranged that the efficiency of the cell is materially increased. Among the advantages claimed for this furnace are (1) reduction of cryolite required in the process and (2) purer end product. Ha (3a)

Treatment of Precious Metal Matte. C. C. Downie. *Metallurgia,* Vol. 13, Nov. 1935, pages 21-22, 25. Describes treatment which consists of sulphate roast, leach in 2% H_2SO_4, and precipitation of Ag from filtered solution by Cu. Insoluble portion of roast, containing some Ag and all Au, Pt, and Pd, is returned to furnace. JLG (3a)

Molding Sand Characteristics for Nickel Bronzes. *Foundry,* Vol. 63, Oct. 1935, pages 38-39, 80. Review of the work of American Foundrymen's Association sand committee giving classification and grading standards. Deals with characteristics for Ni-bronze castings and gives a table showing sand properties for several nonferrous metals. Work was carried out at the foundry of International Nickel Co., Bayonne, N. J. Figures are average of those taken over a long period of time. VSP (3a)

Gating Important Feature in Nonferrous Shop. *Foundry,* Vol. 63, Sept. 1935, pages 30-31, 83, 86. Describes foundry of General Electric Co., Erie, Pa. producing brass, bronze and Al castings. Metal is melted in two 750 lb. electric furnaces and a battery of crucible pit furnaces. One is fired with natural gas, the rest with oil. Metals in all castings must conform to chemical specifications and in most cases to closely held physical standards of transverse and tensile strength, elongation and reduction of area. Amount of metal for each day's operation is made up of ingot metal of known composition and physical properties. Method of gating is one of the most important factors in production of clean and solid castings. All patterns are mounted on boards or steel plates and pattern for forming gate cavity in sand is a definite part of pattern equipment. On new jobs original gating may be modified slightly. Sb-Pb castings of almost unlimited size and weight may be made successfully. VSP (3a)

New Vacuum Process of Die Casting. *Compressed Air Magazine,* Vol. 40, Aug. 1935, page 4811. Al bronze is drawn into a steel die by suction induced by a vacuum pump. Vacuum = 5-25 in. of Hg. Weight of castings varies between 1 ounce and 30 lb. The Al bronze contains 10% Al and 1% Fe. Casting temperature—2050-2300° F. Brinell hardness of casting—130-260 kg./mm.^{2} The outstanding advantages claimed are that the impurities at the top of the melting pot are prevented from entering the die, that a negligible quantity of Al oxide is formed, absence of blow-holes, smoothness and regularity of castings, elimination of hand tooling and finishing. WH (3a)

Reduction by Modern Machinery of "Human Element" in Manufacturing. C. J. Zaiser. *Steel,* Vol. 98, Feb. 3, 1936, page 63. Shows how improved equipment requiring minimum attention from operators, reduces costs and improves quality of products, by giving experience of Ampco Metal Inc., Milwaukee, Wis., founders of Al and Cu alloys. Safety features have been installed on furnaces. All heat treating furnaces are controlled automatically. Use of centrifugal casting equipment increased yield of metal melted from 55 to 80%, eliminated unnecessary cutting and grinding, and eliminated to some extent need for highly skilled operators. Improved metal was obtained by redesigning special alloy oil-burning furnaces to keep combustion of gases away from crucibles, relying upon superheated gases alone for melting. Automatically controlled melting furnaces are used for centrifugal casting of high Cu alloys. MS (3a)

3b. Ferrous

C. H. HERTY, SECTION EDITOR

Physical Tests for Cast Iron. JOHN SHAW. *Foundry Trade Journal,* Vol. 53, Nov. 21, 1935, pages 387-388. Such fundamental points as functions of a test-bar, size of test-bar related to the casting, low-C border line irons, etc. are discussed. The tensile breaking load depends on the closeness of the structure for its results rather than the quality and toughness of the Fe. The irregularity often found in the relative transverse tests is largely due to the fact that these different physical properties are under test. The very closeness of the structure, although showing high tensile results, is against that minute "give-and-take" so necessary in some castings for producing the "damping" effect of the graphite present. There is no doubt that failures due to a comparatively low sudden impact or a quick rise of temperature on the outside have called attention to a weakness sometimes present in the low-C border-line irons, which the present tests with their gradually-applied load do not reveal. In no case should the test-bar as cast be less in diameter or cross-section than the average cross-section of the casting it represents. Schwarz and Väth found that the test-bar should be twice the diameter of the mean cross-section of the casting it represented, if similar structure was required. Referring to the effect of deoxidation and inoculation by ferro-silicon the author mentions that if high-silicon pig or alloy is melted with the charge, the time for the growth of the graphite nuclei is increased. If charged down the spout the result is a finer graphite as proved by both photomicrographs and tests.
AIK (3b)

Production of High Test Cast Iron (Quelques Remarques Practiques sur la Fabrication Actuelle des Pièces en Fontes Resistantes) A. PORTEVIN & R. LEMOINE. *Bulletin de l'Association Technique de Fonderie,* Vol. 9, Sept. 1935, pages 301-304 French exchange paper presented at the International Foundry Congress in Brussels, Sept. 1935. It is necessary to take into account factors other than the chemical analysis of the metal in determining its physical properties. The most important of these factors are: (a) the physico-chemical changes in the furnace, (b) thermal history of the metal in the liquid state, (c) nature and time of additions to the metal, and (d) the nature of the slag. Summary of the latest work and theory on the production and control of high strength cast iron. 16 references.
WHS (3b)

Metallurgical Progress in the Foundry. S. E. DAWSON. *Foundry Trade Journal,* Vol. 53, Nov. 7, 1935, pages 341-342, 344. Extended abstract of paper read before a joint meeting of London and East Midlands branches of Institute of British Foundrymen. Knowledge and understanding of cast iron have advanced more rapidly than that of any other engineering material. Generally speaking, the conditions which produce small-sized graphite also give a small grain size in the structure of the metal with well-known advantages to the strength of the casting. Much evidence is now available to indicate that the inherent properties of the raw materials employed persist through the subsequent remelting in the cupola to influence the resulting metal. In the charcoal melted irons, the graphite was small and well distributed, but in the coke melted irons it was coarse. It is interesting to note the influence on the iron of silicates of iron present in a colloidal or ultra-microscopic condition, sometimes referred to as silicate slime, shown by O. Keil and others to produce large coarse graphite. The assistance rendered by the removal of such silicates by superheating the metal may be a direct contribution to the improvement in structure obtained by such treatment. It would seem quite likely that many valuable properties of the raw materials may be lost or diminished in remelting through the cupola itself, where the conditions of air supply, temperature and composition of the gases are not suitable. In many foundries the air-coke ratio is too low, with the result that carbon pick-up is experienced to the detriment of the structure and mechanical strength, and the temperature of the metal is far from being satisfactory.
AIK (3b)

Slush Pump Piston Cores Produced by Centrifugal Casting Process. A. E. FALK. *Foundry Trade Journal,* Vol. 53, Nov. 21, 1935, pages 379, 382. Read before the Toronto Meeting of the American Foundrymen's Association, in 1935. The castings in question are gray Fe cores for a rubber piston used in slush pumps. The tremendous loads carried by these cores in service caused many cores to crack. To overcome these difficulties it was decided to employ an electric furnace to produce a high-strength Fe and to spin the cores to produce a finer-grained Fe. The centrifugal device is set in a pit, and consists of 2 bowls mounted on opposite ends of a pivoted frame. The bowl with its mold is brought up to 600 r.p.m., when starting to pour. Higher spinning speeds were formerly used, but it was found that lowering the speed gave better mold life. Development of the molds, cooling molds, pouring the castings, mold wash, etc. are discussed by the author. The first molds were made of steel. Cast Fe molds were then tried and found to be much more satisfactory. Many alloy irons have been tried, but only two have given satisfactory results. The first of these contained C 3.50, Si 3.90 and Mn 0.80%. The second had a composition of C 3.20, Si 2.30, Ni 3.50 and Mo 0.50%. Mold life varies from 400 to 700 castings, depending on type and size of castings needed. Many types of prepared washes were used but none would stick. When the molds were smoked, there was a tendency for the smaller castings to have bubble holes on the face of hub. A wash has been developed that protects the face of the mold and at the same time promotes easy stripping. It consists of a diluted refractory cement, core oil and graphite.
AIK (3b)

Heavy Alloy Iron Castings. C. C. MILLER. *Metals & Alloys,* Vol. 6, July 1935, pages 185-186. Obtains strength and shock resistance in heavy castings (up to 3 ft.) by air furnace superheat, using 0.30%-0.50% Mo and 0.25%-0.35% Cr added in heaviest section castings and 0.60% Ni with the Mo for lightest sections (6"). Strength and structure are requisites rather than composition which is only important as a factor in obtaining the desired structure in various sections.
WLC (3b)

Changes Practice in Car Wheels. HENRY MARIUS. *Foundry,* Vol. 63, Sept. 1935, pages 35-36, 99. Discusses factors to be considered when casting car wheels from scrap mixture. A heavier addition of ferrosilicon slowed down melting rate which gave a hotter Fe and absorbed more C from a heavy coke bed. Also annealing temperature was increased from 1420° to 1575° F. and over. Hot melting, hot shaking out and hot pitting produced wheels of increased strength and tenacity under drop and thermal tests.
VSP (3b)

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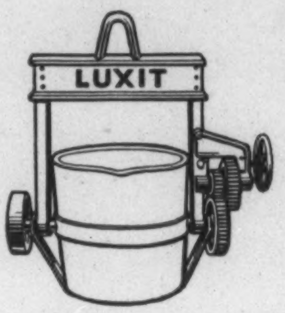

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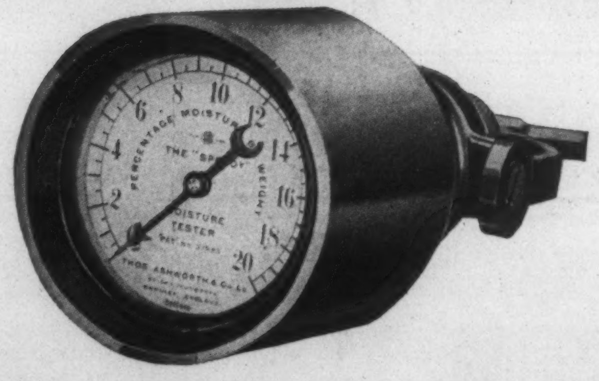

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Nitrogen in Arc Furnace Steel and Deoxidation by Carbide Slag. ISAO HAYASHI. *Tetsu-to-Hagane*, Vol. 21, Sept. 25, 1935, pages 707-722. In Japanese. By chemical analysis the N content in more than 100 slags and metals which were periodically sampled during smelting of 15 charges in a 30 ton basic electric arc furnace were determined. The high N in electric steel is due to $CaCN_2$ produced in carbide slag by the reaction between CaC_2 and N_2 in the furnace. $CaCN_2$ in the slag is more inactive than CaC_2 for O_2 and CO at high temperatures. The minimum value of the ratio $CaC_2/CaCN_2$ in the slag was 0.66. Judging from various behaviors of $CaCN_2$, the reaction between $CaCN_2$ in the slag and the metal bath is assumed to be:

$$CaCN_2 + 2\begin{Bmatrix}FeO\\MnO\end{Bmatrix} \longrightarrow CaO + 2\begin{Bmatrix}Fe\\Mn\end{Bmatrix} + CO + N_2,$$

$$CaCN_2 + CO \longrightarrow CaO + 2C + N_2.$$

N_2 liberated goes into the bath. If the other conditions are similar, the more N in bath increases until the tapping period, the more complete is deoxidation of bath by CaC_2, and the lower the temperature of bath becomes, the more $CaCN_2$ is produced in slag. Even in basic electric arc melting, if the white lime slag method is adopted, steel containing low N may be produced. TS (3b)

Some Notes on Ingot Moulds. T. SWINDEN & G. R. BOLSOVER. *Engineering*, Vol. 140, Sept. 6, 1935, pages 260-262. See *Metals & Alloys*, Vol. 6, Nov. 1935, page MA 441L/2. LFM (3b)

Case Hardening Nickel-Chromium Steel Ingots. SEIJI NISHIGORI. *Denki-Seiko*, Vol. 11, Sept. 15, 1935, pages 480-490; *Tetsu-to-Hagane*, Vol. 21, Sept. 25, 1935, pages 722-726. In Japanese. In 4 case hardening Ni-Cr steel ingots, the fractures and the forms and distribution of non-metallic inclusions were examined in macro- and microstructure.

Weight of ingot	Chemical	Compositions	%	
(kg)	C	Ni	Cr	Remarks
850	0.13	4.18	0.89	Elec. furnace steel
150	0.15	3.37	1.00	Elec. furnace steel
150	0.18	3.30	1.04	Elec. furnace steel
150	0.14	3.53	1.15	Induction furnace steel

Non-metallic inclusions in these ingots, generally, had a nearly true spherical form, and inclusions 0.12 ~ 0.25 mm. in dia. were observable in macrostructure. Number of inclusions was max. at the center of ingot and was min. at the "trans-crystallization zone," of which thickness was about 40 mm. Inclusion was proved microscopically to be iron oxide and not silicate or sulphide. TS (3b)

Importance of Ingot Phase. J. H. HRUSKA. *Blast Furnace & Steel Plant*, Vol. 23, Nov. 1935, page 783. Compared with melting processes, steel makers are giving very little attention to improvements in making of ingots. Economic pressure, however, will lead to chemical and metallographic control of ingot phase, similar to that applied to melting processes. To show importance of ingot phase, tabulates annual production of ingots in gross tons and production in % of capacities existing at end of year for 1921-1929. MS (3b)

Progressive Mechanization. VINCENT C. FAULKNER. *Foundry Trade Journal*, Vol. 53, Nov. 14, 1935, pages 363-368. A study of west of England foundry. Raw materials, iron melting plant, sand preparation, facing sand, molding plant, brass foundry, etc. The paper is well-illustrated with general layout plan, sketches and pictures of different parts of the plant. AIK (3b)

Pennsylvania Steel Foundry Produces Heavy Castings. PAT DWYER. *Foundry*, Vol. 63, Nov. 1935, pages 22-26, 62. Describes plant of Mesta Machine Co., West Homestead, Pa. The company produces Fe and steel castings up to 165 tons in weight. It specializes in the design and manufacture of rolls and rolling mill machinery, gas and steam engines, forging and bending presses, machine tools, cut and machine molded gears. VSP (3b)

Increases Strength with Alloys. PAT DWYER. *Foundry*, Vol. 63, Oct. 1935, pages 24-25, 60. Describes foundry practice of the Chambersburg Engineering Co. Metal is melted in oil-fired air furnaces for steam and board hammers, anvils and related forging equipment. An alloy Fe developed for anvils and frames combining mass and vibration resisting properties of gray Fe and strength and wear of steel. Furnace charge is made up of 70% scrap, 30% malleable pig with low S and P and C under 3.00%. Alloy additions are: 0.30% to 0.50% Mo. 0.35% Cr and 0.60% to 1.5% Ni. Maximum tensile strength of Fe is 50,000 lbs./in.^{2} VSP (3b)

Some Problems in the Manufacture of Southern Merchant Pig Iron. FRANCIS H. CROCKARD. *Metals & Alloys*, Vol. 6, Nov. 1935, pages 318-321. Production at a Southern blast furnace no longer means "how much iron" but "how much good iron." This change makes careful control of raw materials and furnace operation necessary. It is achieving results in improving the competitive position of these furnaces. WLC (3b)

Continuous Pouring of Ford Cylinder Blocks. EDWIN F. CONE. *Metals & Alloys*, Vol. 6, Nov. 1935, pages 299-312. Describes evolution of a continuous process for pouring metal from spout to molds with careful control of composition and pouring temperature. Metal is ordinary gray iron with 0.50-0.75% Cu added. Molten cupola iron is mixed with blast furnace iron in a mixer where analysis is made and composition controlled. Metal at 2400° F. is transferred from the mixer to an arc furnace where it is refined and superheated to 2630° F. and from which it flows by gravity into an air furnace which acts as a reservoir for metal and from which a continuous stream flows into a continuous stream of molds passing it. WLC (3b)

Corby Works of Messrs. Stewart and Lloyds Limited. *Blast Furnace & Steel Plant*, Vol. 23, Dec. 1935, pages 840-848. Describes Fe and steel plant in Northamptonshire, England. Consists of an Fe-ore treating plant; 3 blast-furnaces; coal-washing equipment; 35 cross-over, flue-type by-product coke-ovens and 4 special horizontal coke-ovens; 3 25-ton basic Bessemer converters and a 1000-ton hot-metal mixer; and rolling-mills consisting of 4 soaking-pits, a 40" reversing blooming-mill, 2 reheating furnaces, and a combination cross-country and continuous-type strip mill, having 8 horizontal and 4 vertical stands, capable of rolling strip from 2⅝" to 15¼" wide. MS (3b)

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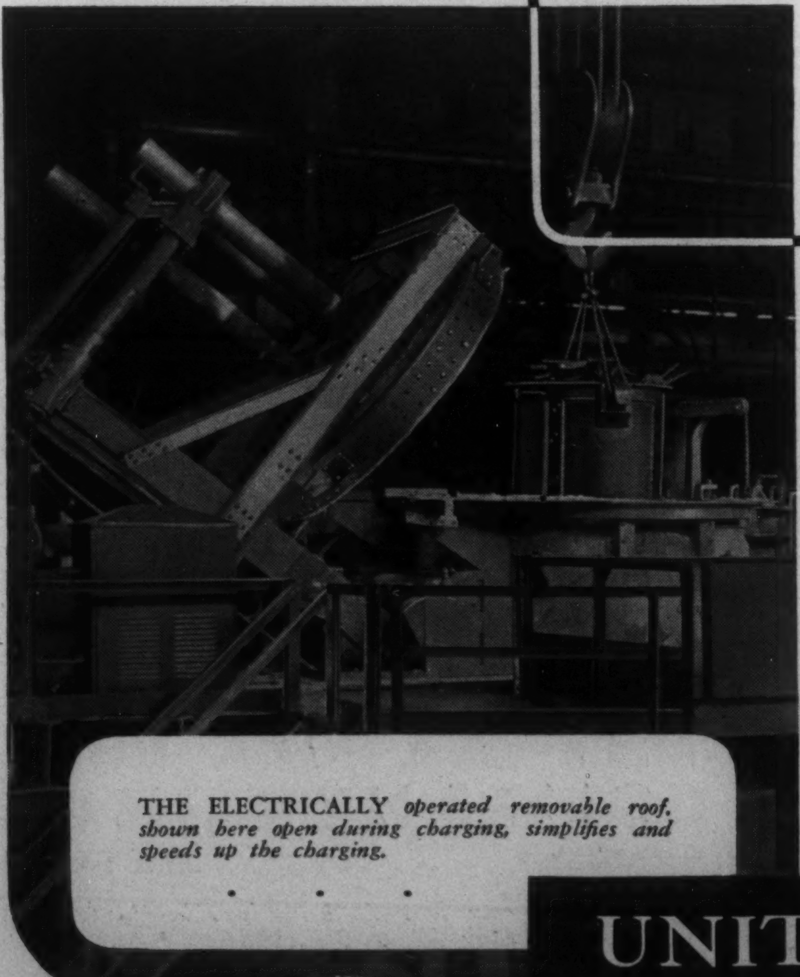

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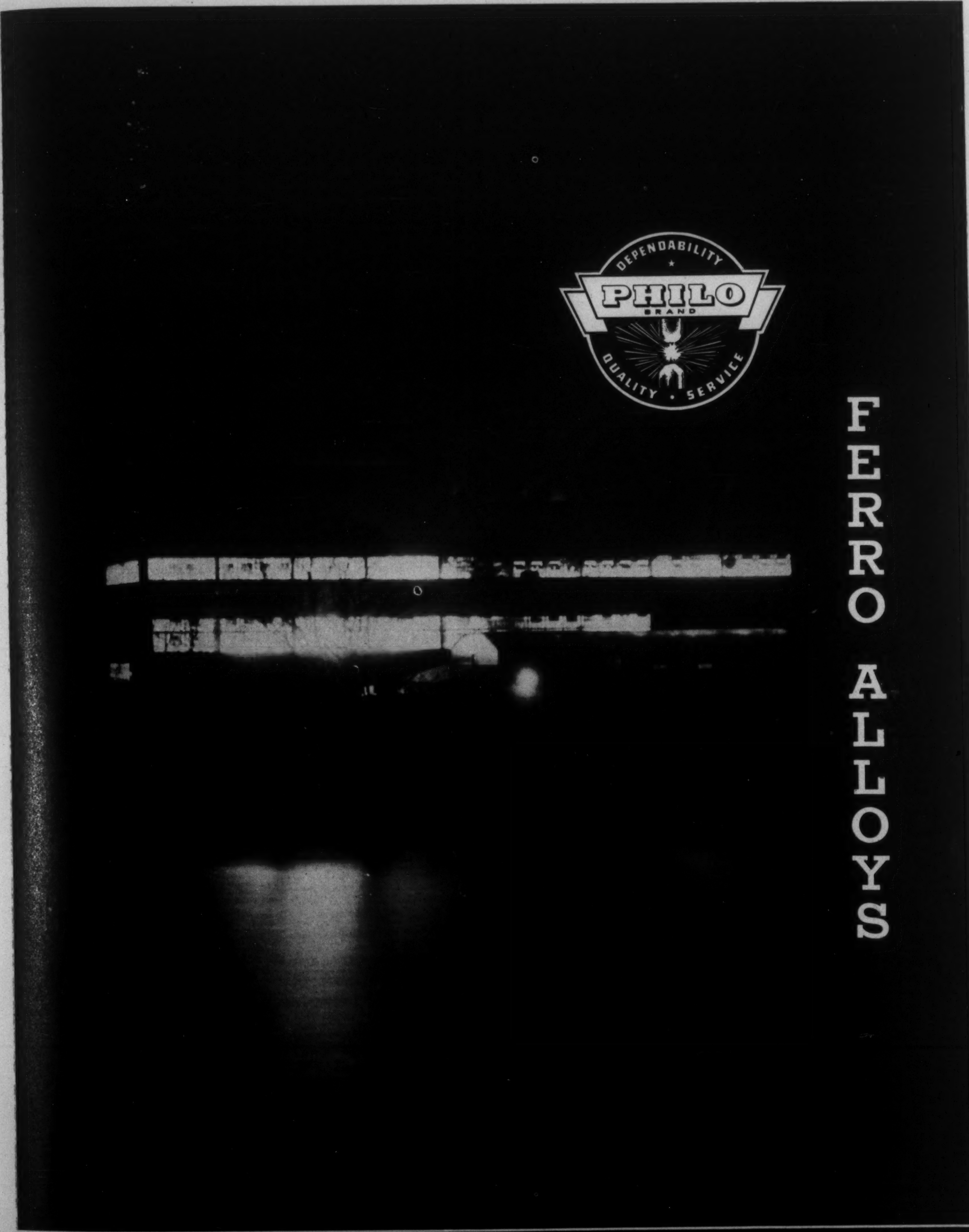
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4. WORKING

Thin Plates, Their Manufacture, Surface Treatment and Working (Ueber Feinbleche, ihre Herstellung, Oberflächenbehandlung und Verarbeitung) Koch. *Oberflächentechnik,* Vol. 12, Dec. 17, 1935, pages 291-292. The manufacturing processes of sheets of 0.5 mm. thickness and less for various industrial purposes and requirements for deep drawing and cold-rolling, are discussed in a general way. Ha (4)

The Manufacture and Uses of Metal Powders. J. C. Chaston. *Electrical Communication,* Vol. 14, Oct. 1935, pages 133-144. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 354L/1. JCC (4)

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Continuous Wide Strip Mill Now Being Built in Russia. M. Stone. *Steel,* Vol. 97, Dec. 9, 1935, pages 32-35, 57. Describes hot and cold mills and auxiliary equipment under construction at Zaporojie, U. S. S. R. Hot mill comprises primarily 2 2-high 1680-mm. scale breakers, a 4-high 2438-mm. broadside mill, a slab reducer, 3 stands of 4-high 1680-mm. roughing-mills each preceded by a vertical edger, and 6 stands of 4-high 1680-mm. finishing mills. Temperature of strip between roughing and finishing stands is controlled by air-blast. Cold mill comprises a 3-stand 4-high 1680-mm. tandem mill, a 4-high 1680-mm. reversing mill, a 4-high 1060-mm. reversing mill, and 2 4-high 1680-mm. skin-pass mills. Strip is kept under tension at all times. Planishing department consists of 2 4-high 1680-mm. sheet planishers, 4 2-high 1060-mm. planishers, and a 4-high 1680-mm. coil planisher Centralized lubricating systems cover entire plant. Practically entire plant is equipped with anti-friction bearings. All roll assemblies are balanced hydraulically. MS (4a)

Controlled Cooling of Rails Improves Structure, Prevents Shatter Cracks. *Steel,* Vol. 97, Nov. 4, 1935, page 64. Experiments by Bethlehem Steel Co. have shown that control of cooling, which would minimize heat differentials in the rail from 950° F. to below the blue-heat range, prevents formation of interior shatter cracks. MS (4a)

Notes on Cold Rolling. J. W. Berry. *Iron & Coal Trades Review,* Vol. 131, Nov. 8, 1935, pages 759-760. An outline of the development of cold-rolling is given, the origin of it is unknown. Scale removal, pickling machines, the rolling process, finishing are discussed in general, and practices of annealing and manufacturing of very thin sheets, as razor blades, briefly described. Ha (4a)

Selection and Use of Shear Blades. M. K. Mellott. *Steel,* Vol. 98, Jan. 13, 1936, pages 26-29. In selecting shear knife-blades it is important to know type of shearing-machine; stroke; speed of shearing; types, thickness, temperature, hardness characteristics, and condition of material to be sheared; importance of quality of cut; and heat treating and machine-shop facilities at plant where blades will be used. Practice of Braeburn Alloy Steel Corp., Braeburn, Pa., is described. MS (4a)

Strip Rolling Speeds Increased. *Steel,* Vol. 98, Jan. 6, 1936, pages 239, 337-338. Reviews developments in rolling-mills during 1935, with chief attention to installations of electrical and auxiliary equipment. MS (4a)

Broad Strip Mills Feature 1935 Expansion. *Steel,* Vol. 98, Jan. 6, 1936, pages 85-88. Reviews 1935 construction activities of the American Fe and steel industry, with chief attention to rolling-mills. MS (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

The Use of the Hele-Shaw Apparatus in the Investigation of the Flow of Metals. A. M. Herbert & F. C. Thompson. *Engineering,* Vol. 140, Sept. 27, 1935, pages 347-348; Oct. 4, 1935, pages 369-370; *Engineer,* Vol. 160, Oct. 4, 1935, page 354. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 8R/9. LFM (4b)

Forgings Meet Close Specifications. *Steel,* Vol. 98, Jan. 6, 1936, pages 219, 221. Gives opinions of several authorities on progress in the forging industry in 1935. MS (4b)

The Manufacture of Tubular Aluminum Articles by Extrusion. O. Kühner. *Engineering Progress,* Vol. 16, Nov. 1935, pages 285-287. The extrusion process for Al parts may be advantageous when the length is a multiple of the diam., and when the bottom must be considerably thicker than the wall, and particularly when bulges and depressions must be formed in the bottom. Examples of extruded parts and machinery are described. Ha (4b)

Power Consumption in Forging and Pressing Aluminum Alloys (Kraftverbrauch beim Schmieden und Pressen von Aluminiumlegierungen). A. v. Zeerleder & R. Irmann. *Zeitschrift für Metallkunde,* Vol. 27, July 1935, pages 145-148. The general problem of working Al alloys is discussed, showing that the power requirements are much greater than for some Cu alloys and comparable to those for Fe. Compression tests to show the effects of single components upon pure Al at temperatures between 20° and 420° C. show that with additions of up to 10% the power consumption increases more for Mg than Cu, while up to 2% Mg_2Si has the least effect of any; commercial alloys of the Al-Cu-Mg and Al-Mg-Si types both require more power than the above results would indicate, due to their Mn content. Trip-hammer experiments on Fe at 900° C, Avional at 420°, Fe at 1100°, Anticorodal at 480°, brass (57.7 Cu, 2.1 Pb, 40.2 Zn) at 700°, and 99.5% Al at 500° showed the power requirements to decrease in the order given. Die-forming of the same materials showed the importance of well polished dies and forms, especially for the Al alloys. GD (4b)

4c. Cold Working, including Shearing, Punching, Drawing & Stamping

Improvement of the Endurance of Key-ways by Surface Working (Die Steigerung der Dauerhaltbarkeit von Keilverbindungen durch Oberflächendrücken). P. Berg. *Mitteilungen des Wöhler-Instituts,* No. 26, 1935, 73 pages. Using C steels of 0.08, 0.13 and 0.27% C, and heat treated carbon steels of 0.41 and 0.62% C, with tensile strengths of 59,000, 68,000, 87,000, 100,000 and 127,000 lbs./in.^{2}, the effect of cold working of key-ways was studied. Cold working of the key-ways and the keys, together with the use of thin brass shim stock between key and key-way gave 5, 15, 35, 40 and 60% improvement in endurance, the improvement increasing with the hardness of the steel. Forcibly taking out and replacing a solid key was found to be harmful. The use of a special key with a spring end that can be moved by hand is desirable. The use of a thin brass shim was helpful with this key also. Every experiment is given in detail and shown by photographs. HWG (4c)

Difference Between Structures Shown by Cold Working. B. L. McCarthy. *Metal Progress,* Vol. 28, Aug. 1935, pages 36-38. Best structure for wire drawing is a finely "pearlitic" one obtained by quenching high C steel in molten lead. This structure is commonly called "sorbite" but sorbite from tempered martensite is unfit for wire drawing. Properly patented wire (lead quenched) shows less than Rockwell C35 and may be reduced 45% in cross sectional area in one draft and as much as 95% in several drafts. WLC (4c)

Wire Drawing of Alloy Steels (Le Tréfilage des Aciers Spéciaux). G. de Lattre. *La Technique Moderne,* Vol. 27, Nov. 15, 1935, pages 745-748. First discusses effects of composition: Ni increases ductility whereas Cr and C decrease it. C content must be less than 0.2% for wire drawing. Mn and P increase brittleness and Si less than 0.25% renders steel more dense. Then reviews effect of heat treatment for pearlitic alloy steels which respond to heat treatment and austenitic steels which do not respond to heat treatment. In this case, when heat treatment is applied its effect is to improve homogeneity. Discusses heat treatment of martensitic steels for which a softening treatment is absolutely necessary. Last section describes various phases of wire drawing process dealing specially with the following 3 classes of steel: (1) Ni steels, (2) Cr steels, (3) Ni-Cr steels. Best heat treatment according to composition and structure is given for each type of steel. Pickling of certain kinds of Ni, Cr and Ni-Cr steels involves special problems. FR (4c)

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Deep Drawing Ability of Thin Sheets and Its Preservation During the Working Process (Die Tiefziehfähigkeit dünner Bleche und ihre Erhaltung im Laufe des Arbeitsprozesses). M. SCHÖNZELER. *Metallwaren Industrie & Galvano Technik,* Vol. 33, May 1, 1935, pages 184-195; May 15, 1935, pages 218-220. Stress-elongation curves of various metals and alloys. Observations on faulty deep-drawn material. Erichsen test. Heat treatment of deep-drawn metals. EF (4c)

Deformation in Wire Drawing. Recent Research on Distortion Characteristics. *Metal Industry,* London, Vol. 47, Aug. 9, 1936, page 132. Abstract of paper by Siebel. See "Deforming Conditions in Wire-drawing," *Metals & Alloys,* Vol. 6, June 1935, page MA 225R/7. HBG (4c)

Progress in the Knowledge and Application of Plastic Forming Processes (Fortschritte in der Erkenntnis und Handhabung der Verfahren zur bildsamen Formgebung) E. SIEBEL. *Metallwirtschaft,* Vol. 14, Nov. 8, 1935, pages 893-897. A review of cold drawing of rods and wire, deep drawing, and drawing tubes, covering power requirements, distribution of forces, effect of die angles and lubrication. 38 references. CEM (4c)

Cutting of Aluminum Bus Bars with a Hand-operated Electric Circular Saw (Schneiden von Aluminiumschienen mit einer elektrischen Handkreissäge) RÖHR. *Aluminium,* Vol. 17, Nov. 1935, page 578. Bars of 10 x 80 mm. were cut in 6 sec., 20 x 80 mm. in 15 sec. with a little saw of 180 mm. dia. Ha (4c)

Stampings Are More Complicated. *Steel,* Vol. 98, Jan. 6, 1936, pages 221, 321. Review of 1935 developments in the stamping and pressed steel industry as seen by several authorities. MS (4c)

The Pressed Metal Industry. O. P. HATTON. *Iron Age,* Vol. 136, Nov. 28, 1935, pages 20-21, 94, 96; Dec. 12, pages 34-36; Dec. 26, pages 26-29. Gives an historical review of metal forming and stamping from the earliest time up to the present. VSP (4c)

Extruding Square-Sectioned Organ Pipes. A. G. AREND. *Machinery,* London, Vol. 47, Dec. 26, 1935, page 377. Process briefly described of square pipe made from round rolled tubing. WB (4c)

Wire and Wire Drawing. A. T. ADAM. *Metal Treatment,* Vol. 1, Winter 1935, pages 172-178. Coarse-grained steel, free from inclusions, is needed for wire-drawing. Plain carbon steels are invariably used, high mechanical properties being achieved by cold working superimposed on a grain-coarsening treatment; heat-treated carbon or alloy steels have not proved successful. The value of patenting is considered to be in its production of a sorbite structure, free from striae. Thorough descaling is important. The mechanical properties of steel wires are discussed. Wiredrawing not only increases tensile strength, but also improves toughness, Izod value, and fatigue resistance. JCC (4c)

■ 4d. Machining ■

H. W. GRAHAM, SECTION EDITOR

Use of Tungsten Carbide in Rotating Machine Tools (Applicazione del Carburo di Tungsteno agli Utensili Rotanti). E. BUGINI. *Industria Meccanica,* Vol. 17, Nov. 1935, pages 983-987. Shape of tungsten carbide tools for best results in machine tool processes, velocity of cutting and energy in h.p. consumed are described. Ha (4d)

Cutting Temperatures Developed by Single Point Turning Tools. O. W. BOSTON & W. W. GILBERT. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 703-726. With discussion before New York Convention A.S.M. 1934. Previously abstracted from Preprint 5. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 516. WLC (4d)

Large Locomotive Bed Castings Machined on Special Equipment. M. M. McCALL. *Iron Age,* Vol. 136, Nov. 7, 1935, pages 26-30; Nov. 21, 1935, pages 22-25, 94, 96. Describes the successful machining of one-piece locomotive bed castings by the General Steel Castings Corporation and some of the machines developed for this work. Some of the equipment developed consist of planer type millers, cross planers, slotters, cylinder borers, drillers, etc. VSP (4d)

Metal Cutting Tools Keep Pace with Machine Tool Progress. A. H. D'ARCAMBAL. *Iron Age,* Vol. 136, Sept. 5, 1935, pages 60-61, 64-66, 73-74, 76, 226, 230-231; Sept. 12, 1935, pages 15-19, 74. **Latest Developments in the Metal Cutting Tool and Gage Field.** *Steel,* Vol. 97, Sept. 30, 1935, pages 34-35. From a paper read at the Machine Tool show. Factors governing metal cutting tools are: (1) Design of tool; (2) Material employed; and (3) Hardening treatment. Most of cutting tools are made from high speed steel. Present day tools are required to machine parts made from wide variety of materials with closer tolerances. Co high speed steel tools of either 4 or 8% Co are in great demand for turning heat treated steel. Another recent high speed steel contains; 0.80% C; 4.00% Cr; 2.10% V; 19.00% W; and 0.60% Mo. Tools made from it show longer life for certain applications than the usual 18-4-1 steel. Another new type is Mo-W containing 0.75% C; 4.00% Cr; 1.00% V; 2.00% W; and 8.00% Mo. Newest development in carbides is the cemented titanium carbide used on steel. Good work is shown by stellite and J-metal. Considers also the nitriding and Cr plating of tools. VSP + MS (4d)

The Working of Sheet Aluminium. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 14-16. Sharp tools, with adequate clearance, should be used for machining aluminium. Drawing, spinning, frosting, and burnishing are briefly discussed. JCC (4d)

The Machining of Stainless Steels. *Machinery,* London, Vol. 47, Nov. 14, 1935, pages 194-196. Practical article on speeds, feeds, angles for drilling, turning, shaping and planing for austenitic Firth Staybright and martensitic Firth Stainless. WB (4d)

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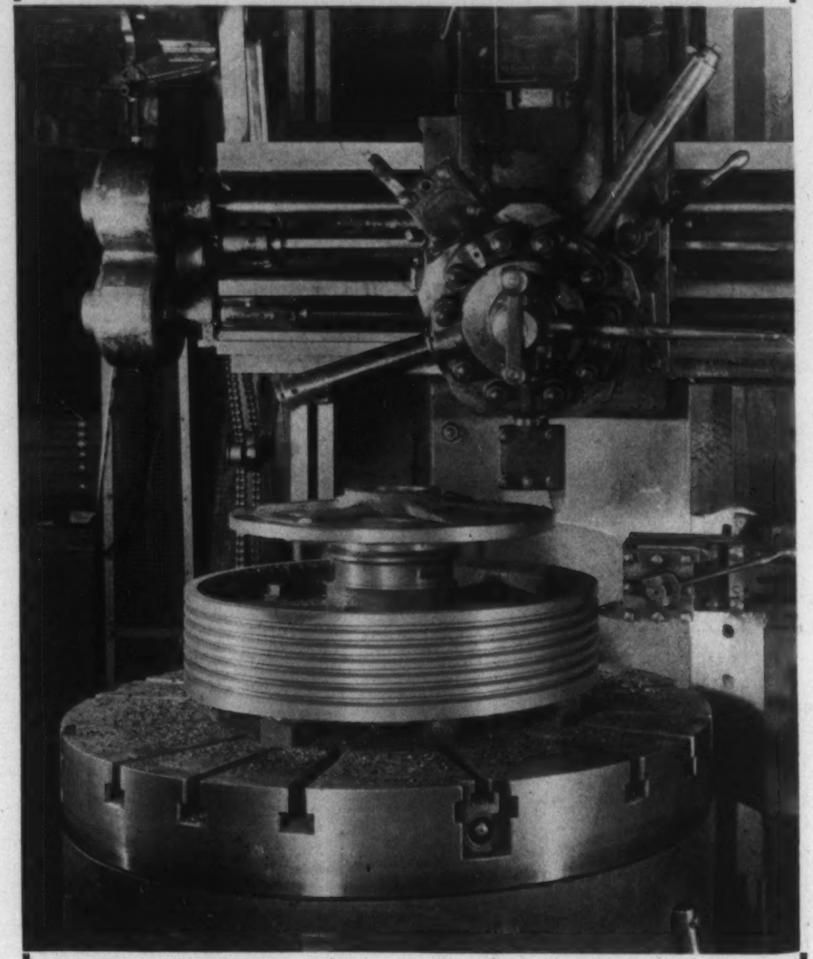

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Depth of Cut	3/16—1/4 in.	1/32 in.	7/8 in.
Feet per rev.	1/16 in.	1/64 in.	1/64 in.

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5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Process of Treating Metals and Alloys (Verfahren zur Behandlung von Metallen und Metall-Legierungen) Société d'Exploitation des Procédés Mahoux, Paris. *Oberflächentechnik*, Vol. 12, Dec. 3, 1935, pages 285-286. The new process, DRP 621,200, of treating steels and Fe alloys is based on the fact that materials upon heating are put into molecular vibrations. It was found that the quality of metallic structure is changed if in the metals or alloys under a heat treatment, electromagnetic or mechanical vibrations of ultrasonic frequency are generated which practically do not contribute to the heating; this is of particular advantage for treatment of materials with low transformation temperatures, e.g. C steels at 500° C. which must not be exceeded. The frequency of the ultrasonic oscillations, is between 1 and 10 million per sec. In the presence of these oscillations, cementation and nitriding can be done at lower temperatures than usual, as C and N penetrate into the surface and harden it. Ha (5)

Heat Treating Practice Refined. *Steel*, Vol. 98, Jan. 6, 1936, pages 217-218, 320-321. Gives opinions of various authorities on progress in metallurgy and heat treatment in 1935. MS (5)

The Ferrous Metal Industry. HALE A. CLARK. *American Gas Journal*, Vol. 143, Nov. 1935, pages 25-28, 74. The operations of hardening, normalizing, process or shop annealing, box annealing, tempering or drawing, graphitizing, carburizing, cyaniding, nitriding, Chapmanizing and forging are briefly discussed with special emphasis on the furnaces used and the operation. Insulating refractories are also briefly discussed. CBJ (5)

Thermal Treatment and Selection of Steel for Complicated Cold Working Dies. D. M. SKOROV & Z. I. SLUTZKI. *Kachestvennaya Stal*, No. 9, 1935, pages 46-55. In Russian. Lack of symmetry leading to non uniform heat removal is the usual cause of failure. Several examples of properly and improperly designed dies are given with appropriate explanations. Quenching qualities of die steels were studied on flat cylindrical samples having an eccentric opening and a slot in the thinnest portion. Following steels were tested: 0.95-1.09% C, 0.15-0.25 Mn, 0.30 max. Si; 0.60-0.75 C, 0.2-0.4 Mn, 0.30 max. Si, 3.2-3.8 Cr; 0.5-0.6 C. 0.5-0.8 Mn, 0.35 max. Si, 0.5-0.8 Cr, 1.4-1.8 Ni, 0.15-0.30 Mo; 0.40-0.50 C, 0.40-0.60 Mn, 0.45-0.75 Si, 5.0-5.5 Cr, 4.5-5.0 W, 0.2-0.3 V; 1.45-1.70 C, 0.35 max. Mn, 0.50 max. Si, 11.0-12.5 Cr, 0.5-0.8 Mo, 0.15-0.30 V; 0.70-0.8 C, 0.30-0.40 Mn, 0.45-0.75 Si, 1.25-1.75 Cr, 2.25-3.50 W. Position in quenching and the changes in dimensions after treatment are recorded for different thermal cycles. Detailed figures submitted indicate that for simple dies of moderate strength steel with 0.95-1.09 C, 0.15-0.25 Mn and 0.30 max. Si is the best. For stronger dies having a complicated shape 0.70-0.80 C, 0.3-0.4 Mn, 0.45-0.75 Si, 1.25-1.75 Cr, 2.25-3.50 W can be recommended. For the most severe requirements in regard to strength, low deformation and freedom from quenching cracks steel with 1.45-1.70 C, 0.35 max. Mn, 0.50 max. Si, 11.0-12.5 Cr, 0.50-0.80 Mo and 0.15-0.30 V should be used. Heat treating cycles giving optimum results for these steels are given. (5)

Note on Heat Treatment of Welds. *Engineer*, Vol. 160, Oct. 25, 1935, page 428. From the Technical Report for the years 1933-1934 of the British Engine, Boiler and Electrical Insurance Company, Limited. LFM (5)

■ 5a. Annealing ■

Atmosphere for Annealing High Brasses in Relation to Buffing. L. KROLL & E. A. ANDERSON. *Metals & Alloys*, Vol. 6, July 1935, pages 192-193. Study shows that for atmospheres investigated the surface condition for tinning or electroplating obtained, falls in the following order of excellence, dry H_2, air, N_2, and city gas. Presence of oil on the work must be avoided when H_2 is used. WLC (5a)

Annealing Thin Sheet Metal (Contribution à l'Étude du Recuit des Toles Fines). GEORGES DELBART. *Chimie et Industrie*, Vol. 31, Spec. No., Apr. 1934, pages 454-463. Discusses box annealing of sheets, and reviews influence of cold and hot rolling and annealing on the secondary crystallization and gives the measurements on the decarburizing action and on the coalescence from the point of view of structure and mechanical properties. MAB (5a)

■ 5b. Hardening, Quenching & Drawing ■

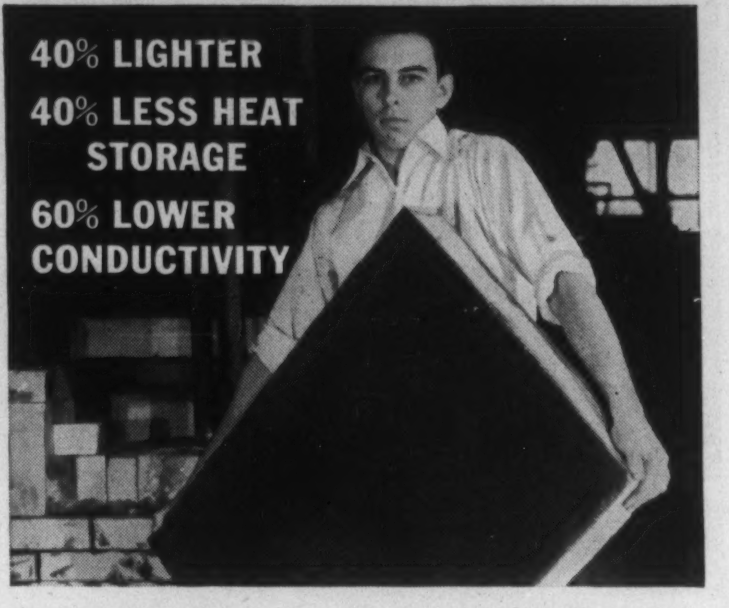
Quenching Power of Liquid Hardening Agents (Ueber das Abschreckvermögen flüssiger Härtemittel). K. G. SPEITH & H. LANGE. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf*, Vol. 17, No. 14, 1935, pages 175-184. Reliable steel hardening requires that the temperature during the hardening process be such that the conversion of the austenite takes place in that temperature range where the disintegration of the austenite of the steel to be hardened produces the best hardness. The conditions leading to this end are discussed and the means given in literature reviewed. The cooling velocity is of paramount importance; it depends, at high temperatures, on the thickness of the vapor film produced around the object to be hardened. Laboratory tests indicated that the quenching power of water might be influenced by additions of "pectinite" (a water-soluble substance consisting essentially of high-molecular, non-crystallizing substances made from apples, citrus fruits, etc.); it reduces the cooling action of water; an addition of 6-7% produces in water the same effect as that of the usual hardening oils. Distilled water was found to quench much more slowly than tap water. Cooling curves were determined in different quenching solutions, methods are described and the heat-flow in the quenching agents measured. 7 references. Ha (5b)

Distortion, Its Prevention and Cure. H. M. DARLING. *American Machinist*, Vol. 80, Jan. 1, 1936, page 25. To overcome deformation in the manufacture of twist drills a combined hardening and straightening device was developed for the heat treatment. Ha (5b)

Quenching Chromium-Molybdenum Tubing in Hot Baths. N. S. ALFEROV. *Domez,* No. 8, 1935, pages 45-60. In Russian. Published work on austenite decomposition is reviewed. Strips 100 x 30 x 3 and 100 x 30 x 5 mm. were cut from the tubes containing 0.25-0.35 C, 0.4-0.6 Mn, 0.25 max. Si, 0.8-1.0 Cr, 0.15-0.20 Mo. They were heated in a salt bath at 900°, 950° and 1000° C. and quenched in salt baths at 250°, 200°, 350° and 400° C. After leaving them at these temperatures for 1 to 60 sec. they were requenched in water. A magnetic device according to Esser, *Stahl und Eisen,* 1927, was used to measure the transformations, readings being taken every 5 seconds. Speed of decomposition of austenite in these steels is greater than in eutectoid C steels. Transformation within the range 250°-400° C. occur within a few seconds. No supercooling range with a low austenite decomposition speed was found for them. Short immersion periods, 1 to 5 seconds, are not sufficient for producing the critical speed of cooling, even at 250° C. With longer immersion intervals transformations take place in the first bath. With higher temperatures, 350°-400° C., the processes of diffusion are predominant and sorbite is formed. With lower temperatures 250°-300° C., regular martensitic structure is produced. Intermediate quenching at 250°-400° C. does not give satisfactory results for these steels on account of the rapid decomposition of their austenite. 23 references. (5b)

Heat Treatment of Structural Steels (Die Warmbehandlung von Konstruktionsstählen) H. KALLEN & H. SCHRADER. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Nov. 30, 1935, pages 1439-1442. The various processes of hardening by heat treatment, precipitation, surface treatment and nitriding are briefly described and compared. Surface treatment improves the wear resistance, and also endurance strength because of the increase of strength in the marginal zone. 10 references. Ha (5b)

Influence of the Producing Process and the Fluctations in the Analysis on the Limits and Depth of Hardness of Some Low-alloy Steels (Einfluss des Herstellungsverfahrens und der Analysenschwankungen einiger schwachlegierter Stähle). O. HENGSTENBERG & E. HOUDREMONT. *Technische Mitteilungen Krupp,* Vol. 3, Nov. 1935, pages 189-195. A Ni, a Ni-Cr and a Ni-Cr-Mo steel in which the 3 alloying elements varied in certain limits and the processes of manufacture, which are described in detail, were investigated to determine how depth of hardness and limit of hardenability are related. It was found in all 3 steels that finely distributed inclusions reduce the depth of hardness while the limits of hardenability are widened. On the other hand, Cr and Mo increase the depth of hardness while the hardening limits are narrowed. Si and Ni increase both depth and limits of hardness. The sensitiveness to overheating increases with the growth of the austenite grain which also reduces the depth of hardness and thus corroborates the results of other investigators. 13 references. Ha (5b)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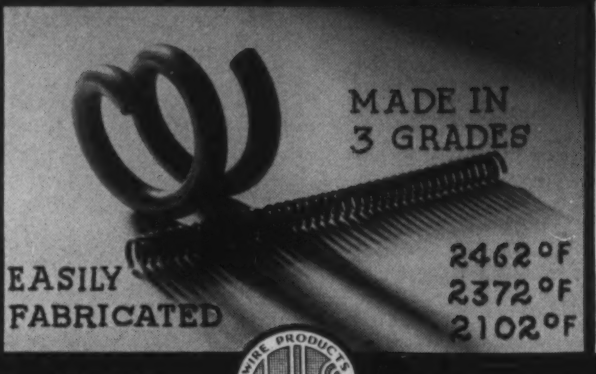

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Grain Size Vs. Draw Temperature. JOSEPH A. DUMA. *Metal Progress,* Vol. 28, Dec. 1935, pages 48-49. Gives graph for determining appropriate draw temperature for quenched S.A.E. 1050 forgings based upon C, Mn, grain size, holding time and desired Brinell hardness. Use of this chart has minimized variations in treatment of this class of work. WLC (5b)

Quenching Stresses (Ueber Abschreckspannungen). G. WASSERMANN. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf,* Vol. 17, Nov. 13, 1935, pages 167-174. Roentgenographic examinations of the interior stresses in quenched specimens of different materials showed that differences in pressure are produced in quenching on the surface of the specimens. In general it was found that specimens of about 1 mm. diam. are entirely or almost free of stresses, that with increasing diam. of the specimens the stresses increase first rapidly, then more slowly up to a maximum. The stresses increase also with increasing quenching temperature. The max. stress in commercial Al was reached at about 7 mm. diam. with 5-6 kg./mm.^{2}, pure Al develops practically no quenching stresses. Ingot Fe showed stresses up to 75 kg./mm.^{2} 26 references. Ha (5b)

5c. Aging

Precipitation Hardening of Steel and Iron Alloys. N. A. MINKEVICH. *Kachestvennaya Stal,* No. 9, 1935, pages 5-16. In Russian. Generally accepted theoretical conceptions are given as introduction, covering both the mechanism of precipitation and property changes produced by it. Specimens prepared from 0.03% C, 0.0 Mn, 0.02 Si, 0.0 Ni, 0.05 Cr, 0.012 S and 0.06% P in the shape of cylinders 20 mm. diameter and 6-8 mm. high were quenched from 600, 700, 750, 850 and 950° C. in water and aged up to 60 days at room temperature. Data obtained support the results obtained by A. Allan Bates, Aging in Low Carbon Steel, *Transactions American Society for Steel Treating,* Vol. 19, 1932, page 449, with the exception that no troostite-martensitic structure was observed which can be associated with the difference in dimensions and Mn content of the samples used in both investigations. Aging of similarly treated specimens at 100°, 150° and 225° C. showed that one hour at 100° C. is not sufficient while 2 hours cause coagulation of the precipitate, one hour at 150° C. produces a maximum hardness and one hour at 225° C. reduces the hardness of samples below that obtained on quenching. These values do not agree with Bates (*loc. cit*) and of Masing, *Archiv fuer Eisenhuettenwesen,* Vol. 2, 1928, pages 185-196, indicating that the aging characteristics of steel depend on its composition which was different in these 3 cases. Preparing specimens by forming Brinell impressions on their flat surfaces, measuring hardness produced at their bottoms with a Rockwell machine and subjecting these specimens to the same heat treatment as in the previous series showed that cold deformation accelerates precipitation hardening, though the increase in hardening produced after its application is lower. Precipitation hardening of non deformed and cold deformed specimens taking place at room temperature produces a pronounced increase in hardness, but aging after artificial aging is much less. Wire made of 0.07% C, 0.026 Si, 0.21 Mn, 1.57 Cu, 0.043 S and 0.028 P was quenched and drawn between 150° and 650° C. for different times. Testing its physical properties supported the results obtained by F. Nehl, *Stahl und Eisen,* Vol. 50, 1930, page 678, and by H. Buchholz & W. Koester, *Stahl und Eisen,* Vol. 50, 1930, page 687, though the composition of steels used by them was somewhat different. (5c)

The Effect of High Hydrostatic Pressure on Aging. LELAND RUSSELL VAN WERT. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 633-644. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 518. WLC (5c)

5e. Carburizing

Carburising Practice. C. C. HODGSON. *Metal Treatment,* Vol. 1, Autumn 1935, pages 127-131. Choice of material for carburising boxes is not easy: 90% of failures in heat-resisting cast boxes is due to extrinsic defects and not to lack of heat-resisting properties in material. Best practice in solid, cyanide, and gas-carburising is discussed. In box carburising, depth of case is influenced more by temperature than by strength of carburiser, and too great an amount of compound is uneconomical and unnecessary. Cylindrical components, for instance, may usually touch and yet leave room for sufficient compound. JCC (5e)

Steel Given Stainless Surface by Adaptation of Chromizing Process. *Steel,* Vol. 98, Jan. 27, 1936, pages 48-49. Describes attempts to make chromizing of steel commercially feasible for imparting corrosion and heat resisting properties to steel surfaces. Bars or billets are placed in a container with powdered Cr and certain compounds and heated to 2400° F. for a specified length of time. It is recommended that depth of case be 4-4.7% of diam. of bar; surface layer contains 25-30% Cr. Coated material may be rolled into various forms. Original working should be done hot, and after suitable reduction, hot or cold working may be carried on without affecting the surface deleteriously. Heating temperatures for hot rolling are somewhat lower than with mild steel. Estimated cost of chromizing is about 4c/lb. of steel. MS (5e)

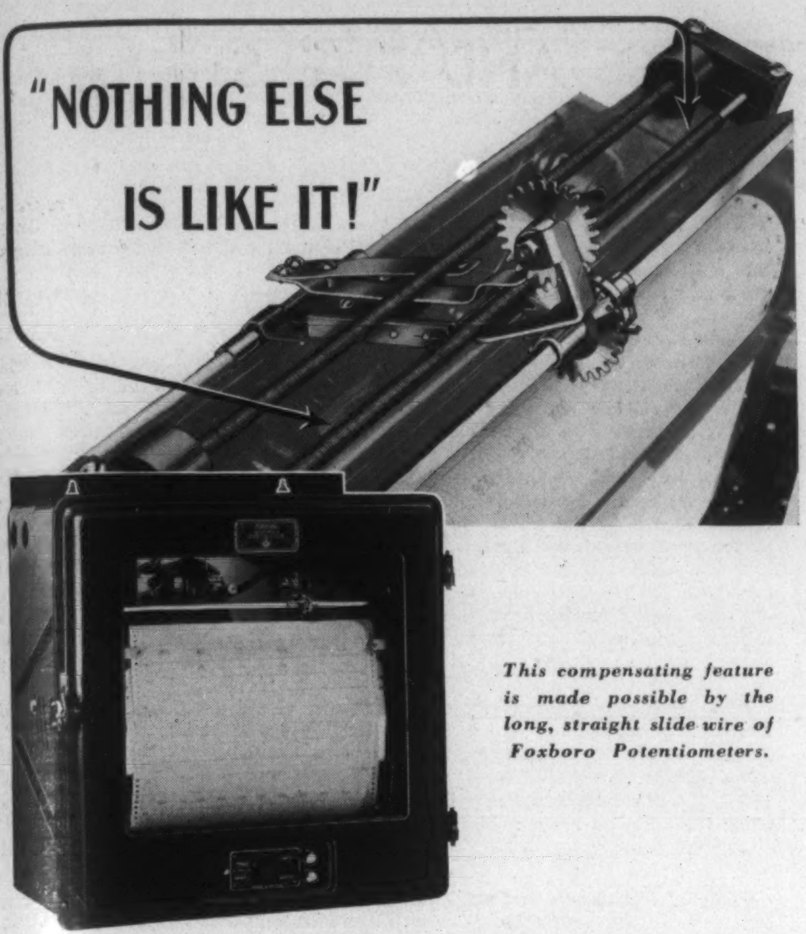
Electrolytic Cementation of Iron (Elektrolytische Zementation von Eisen) E. H. KLEIN. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Nov. 30, 1935, pages 1435-1438. The possibilities of electrolytic deposition of C for cementation of Fe were investigated, alkali and alkaline earth carbonates, alone or mixed with chlorides were examined. The mechanism of the deposition consists in a temporary electrolytic deposition of the alkali or alkaline earth metal which reduces its own carbonate to CO or C which substances act as carburizers. The influence of carbonate concentration, of current density, time and temperature on the cementation process is shown in tables and curves. The efficacy of carburization increases in the order: K-, Na-, Li- and Ba-carbonate. For technical application, a mixture of Ba carbonate and Ba chloride in the eutectic composition of 43% by wt. of $BaCO_3$ seems to be most suitable. Immersion baths of Na_2CO_3 are best for high temperatures. The economy of the process depends on the cost of the electrolyte and the current. Ha (5e)

Gaseous Carburization of Steel. HAROLD C. MCKAY, JR. *Bachelor's Thesis, Massachusetts Institute of Technology,* Boston, 1934, 52 pages. S.A.E. 1020, 3312 and 4615 steels were carburized for 5, 10, 15, and 20 hour periods at 1650° F. in a tube furnace, using 12 to 15 drops of Vapocarb oil/hr. as a carburizer. One 5 hr. run was made using transformer oil, and the carburization was spotty. The carburized samples were furnace cooled and reheated to the proper temperature for quenching. The S.A.E. 1020 steel was water quenched; the S.A.E. 3312 and 4615 steels were oil quenched. 4" heat treated specimens were taper ground, tested for Rockwell "C" hardness throughout the case depth, and depth-hardness curves plotted. In a given time the order of the depth of case produced was S.A.E. 4615, 3312, 1020. To produce a .08"-.10" case using Vapocarb oil at 1650° F., requires approximately 15 hrs. for S.A.E. 1020 and 3312, and about 13 hrs. for S.A.E. 4615. The maximum case hardness of the heat treated specimens was 63, 59 and 58 Rockwell "C" for the S.A.E. 1020, 4615 and 3312 steels respectively. The 3312 steel retained its hardness to a greater depth than the other steels, and also had the highest core hardness. 13 references. CWS (5e)

5f. Nitriding

Properties of Some Aluminum-free Nitriding Steels. E. R. CARR, JR. *Bachelor's Thesis, Massachusetts Institute of Technology,* Boston, 1934, 69 pages. The object of the investigation was twofold: 1. To develop a steel suitable for castings to be nitrided. 2. To develop a wrought steel which would have approximately the desirable properties of the present nitriding steels without the disadvantages arising from the use of Al as an alloying element. The properties of 4 cast steels containing from .18-.40% C, 2.5-4.0% Cr, .35% Mo and .25% V and 2 wrought steels containing .17% C, 2.30-4.20% Cr, .35 Mo and .27% V, were investigated. After normalizing, hardening and tempering, test pieces were nitrided at 960° F. for 48 hrs., then taper ground to a taper of .015 inch per inch. After determining the depth characteristics on both the Rockwell N and Vickers machines, the pieces were reheated to 1000°, 1100°, 1200°, 1300°, 1400° F. for 4 hours. then tested for retention of hardness. Case toughness was tested with an ordinary Brinell machine. Nitrided specimens were tested for 100 hrs. in 20% salt spray. Tensile and impact properties are given for all steels studied. Susceptibility to case scoring was determined by the use of a wear testing machine. For wrought steels, those tempered between 1150° and 1200° F. gave the best combination of properties; the nitride case retained its hardness up to 1200° F. without serious softening. Maximum hardness for the various steels ranged from 78-85 Rockwell "N." 7 references. CWS (5f)

Progress in Nitrogen Case-Hardening. H. SUTTON. *Metal Treatment,* Vol. 1, Autumn 1935, pages 143-145. Brief account of the development of the nitriding process in which special steels are heated for 40 to 120 hours in an ammonia atmosphere at about 500° C. Composition and properties of suitable nitriding steels are described. 9 references. JCC (5f)



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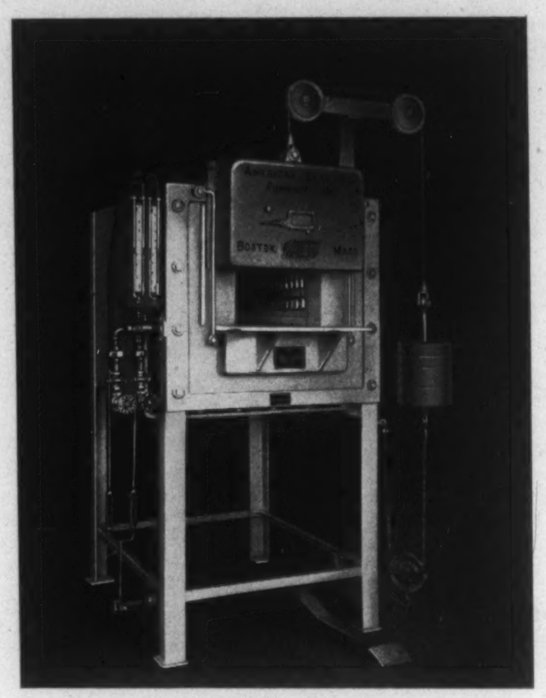

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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Industrial Furnace Atmospheres. C. GEORGE SEGELER. *American Gas Journal,* Vol. 143, Dec. 1935, pages 9-12, 45, 47, 48, 50. Industrial furnace atmospheres have been divided by popular conception into (1) neutral, (2) oxidizing and (3) reducing. Neutral atmospheres are considered those in which there is practically no O_2 nor any substantial amounts of CO or other unburned gases. Since water vapor and CO_2 are strongly oxidizing at elevated temperatures this idea is no longer valid. A completely muffled hearth cannot be considered as having a neutral atmosphere because infiltration of air cannot be completely prevented. Presence of excess air gives an oxidizing atmosphere. The amount of excess air often is of importance, for example certain operations such as core baking and vitreous enameling require strongly oxidizing atmospheres, while a very small amount of O_2 is required in an atmosphere for the prevention of decarburization and scaling in the hardening of tool steels. Reducing atmospheres have varying characteristics, depending upon the reducing agent, its amount, and the function of the atmosphere. Methods of control of furnace atmospheres are discussed. Information on the type of atmosphere recommended for specific uses, how produced, the recommended composition, limitations of composition, and the temperatures is given in outline form. 23 references. CBJ (6)

Charging Machine for Copper-Refining Furnaces. *Engineering,* Vol. 140, July 19, 1935, pages 63-64. Describes machine made by The Wellman Smith Owen Engineering Corporation of London for the works of the Rhokana Corporation of Northern Rhodesia. The machine is especially designed for loading cathode Cu into reverberatory furnaces. In this process the furnace must be filled rapidly and the maximum capacity of the furnace must be utilized. This machine fills a furnace of 200 tons capacity in 2 hr. LFM (6)

Plant for Making Blast-Furnace Coke. *Engineering,* Vol. 140, July 19, 1935, pages 67-68. Editorial commenting on a report of the Midland Coke Research Committee which states that by-product oven coke proved to be inferior to beehive coke in a crucible steel furnace. In a paper by A. Fisher read before the Institute of Fuel in Apr. 1935 the Knowles oven was recommended for making metallurgical coke. These statements lead to the supposition that sometime in the future an entirely new type of oven will be developed which will produce coke of better quality than present by-product coke. LFM (6)

Switch Developed for Automatic Control of Rocking Furnaces. *Steel,* Vol. 97, Nov. 25, 1935, page 32. **Automatic Control on Detroit Rocking Furnaces.** *Heat Treating & Forging,* Vol. 21, Nov. 1935, page 543. See "New Automatic Control on Detroit Rocking Furnaces" in *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 524. MS (6)

Electrically Heated Industrial Furnaces. R. BOYE. *Engineering Progress,* Vol. 16, Nov. 1935, pages 265-272. A review of types of electrical furnaces developed for metallurgical processes and in practical use for various temperature ranges; heat-resistant materials used in them, temperature and atmosphere control, and economical advantages are discussed. Ha (6)

Performance of Refractories Used in Basic Alloy Steel Production. *Brick & Clay Record,* Vol. 87, Dec. 1935, pages 206-208. The importance of refractories in steel production is discussed and correct selection is stressed. Silica brick are particularly suitable for use in roof and side-wall construction of an open-hearth as they retain their load-carrying capacity to within 100° F. of their fusion point; besides, this brick has a high resistance to spalling and to basic slag conditions although it is acid chemically; it forms immiscible liquids with ferrous, Ca, Mn and Mg oxide; this formation is, however, hindered by Na and K oxides. Magnesia bricks are good for the hearth construction. Electric arc furnaces require the same refractories as open-hearth furnaces. Fire-clay brick is unsuitable for ladle-lining as it is too easily attacked by the slag used for covering the steel. A good basic material is not yet obtainable. Refractories for side-walls, roofs, bottoms of soaking pits and forging furnaces should be so selected as to exclude possibility of the surface of the metal being contaminated by spalls or drops of molten refractory matter. Ha (6)

High Temperature Electrical Resistance Furnace. G. W. ASHTON. *Mechanical World & Engineering Record,* Vol. 48, Sept. 13, 1935, pages 245-246. Practical details of construction using metallic resistors are given. Instead of silicon carbide elements, Kanthal is utilized permitting a working temperature of 1300° C. The furnace chamber is built of sillimanite bricks and cemented together with alundum cement. The metallic resistor Kanthal must be well supported. WH (6)

Controlled Atmospheres in Steel Treating. P. B. CROCKER. *Metals & Alloys,* Vol. 6, Nov. 1935, page 331. Takes exception to certain data in correlated abstract on this subject appearing in *Metals & Alloys,* Aug. and Sept. Points out that closely adhering scale prevents decarburization and its occurrence in thin coating may be readily overlooked and lead to incorrect conclusions regarding the effectiveness of certain atmospheres. WLC (6)

Electrical Heat in Industry (Elektrowärme in der Industrie). OTTO DEUTZGER. *Elektrizitätswirtschaft,* Vol. 34, Sept. 5, 1935, pages 559-561. Brief review of utilization of electric heat in steel industry and lengthy discussion on bright annealing of steel wire in electric furnaces. WH (6)

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Industrial Uses for Gas in Metallurgy (Les emplois industriels du gaz dans la métallurgie) J. de Croes. Imprimerie medicale et scientifique, Brussels, 1934. Paper, 8¼ x 12 inches, 138 pages.

Profusely illustrated with photographs and sketches to show the construction of many types of furnaces and burners. Metal melting, galvanizing, tinning, forging, rivet heating, billet heating, heat treating, annealing, carburizing, brazing, soldering, enameling and lacquer drying furnaces are thus described

The illustrations are largely those of Surface Combustion Co. furnaces installed in the U. S. A., together with a variety of makes used in England, Germany and a few other countries. Data on production and gas consumption are usually given, and often compared with other fuels, with prices taken so that gas always shows up ahead of oil or whatever other fuel is being compared, as would be expected since this is a propaganda publication of the Belgian Gas Association.

Information on methods for automatic temperature control is extremely scanty. Radiant tube heating is not touched upon, and controlled atmospheres hardly mentioned.

The pictures are interesting. The theme that any metallurgical furnace heated by a gas burner shows the ultimate in performance gets rather tiresome by the time the reader gets to page 138. More emphasis on the possibilities for automatic control and more information on the proper placing of burners in respect to the charge, added to the data given, would have helped. It could have been made a worth-while engineering aid instead of such obvious propaganda. The reader who is willing to study the illustrations and to read the text with the understanding that it invariably puts the best foot forward for gas can get useful information from it. H. W. Gillett (6) -B-

Foundry Coke. W. E. Mordecai. *Foundry Trade Journal,* Vol. 53, Dec. 12, 1935, pages 437-439; *Iron & Coal Trades Review,* Vol. 131, Dec. 13, 1935, page 984. Paper read at a joint meeting of the Institute of British Foundrymen and Coke-Oven Managers' Association. Chemical and physical properties, C and S in coke, ash content, density of coke, size of foundry coke, etc. are discussed. AIK + Ha (6)

A Comparison of Some Melting Furnaces in a Gray-Iron Foundry. T. R. Twigger. *Foundry Trade Journal,* Vol. 54, Jan. 2, 1936, pages 3-6. A paper read before the East Midlands Branch of the Institute of British Foundrymen. Choice of furnace for gray-iron melting, basis of melting costs, cupolas, rotary pulverized coal-fired furnaces, rotary oil-fired furnaces, crucible furnaces, electric furnaces, furnace linings, melting losses, etc. are discussed by the author. In the author's opinion the next decade is likely to witness the still further adoption of rotary furnaces for gray-iron melting and also a considerable extension of electric-furnace melting for high-grade castings. AIK (6)

The Manufacture of Plain Carbon Steels in Top Charge Rapid Type Furnace. W. B. Wallis. *Paper, Electrochemical Society,* Oct. 1935, pages 445-452. The furnace described is roughly the shape of a short cylinder standing on end. The removable top is a heavy disc shaped cover through which the electrodes pass. This cover can be raised and swung to one side thus exposing the furnace interior. Charging can be done in 5 minutes or less compared to the 30 to 60 minutes required with side door charging. Heat losses are reduced and power saving amounts to from 5% to 10% and electrode saving more than 10% over the old side door charging method. GBH (6)

Furnaces for Forging and Bending Pipe. J. B. Nealey. *Heat Treating & Forging,* Vol. 22, Jan. 1936, pages 37-38. Describes St. Louis plant of Midwest Piping & Supply Co. Van Stone machine for forging and flanging of pipe requires 3 gas-fired portable furnaces to heat the different sizes. They are of brick construction, circular in shape, and just long enough to accommodate short length of pipe that must be heated. Brick furnace for heating pipe for bending is gas-fired and has a permanent center portion containing combustion and heating chambers. Length can be increased by building sections on ends. Top is a removable arch made of sections, each consisting of a cast-Fe arc holding an arc of firebrick. Roof sections are counterweighted. MS (6)

Dimensions and Lines of Modern Blast Furnaces (Les dimensions et le profil d'un haut-fourneau moderne) M. A. Pavloff. *Revue de Métallurgie,* Vol. 32, Oct. 1935, pages 451-465. A survey of the contemporary design of blast furnaces in Europe and the United States. The diameter of the hearth has steadily increased in the United States reaching 8.2 m. in No. 4 stack at Aliquippa and 8.7 m. in No. 3 stack at the same plant. Experts object to this size even in the States; in Germany it is not approved, because large and economical production can be obtained with much smaller hearth dimensions. Blast furnace No. 8 at Thyssen Works has a useful volume of 840 $m.^3$ and a 6.5 m. hearth, but it steadily produces an average of 1100 tons a day. Germans maintain, that production of a blast furnace is proportional to the diameter of its hearth but not to the square of it. These ideas were incorporated in the construction and remodelling of the contemporary blast furnaces in Russia. The author gives the dimensions of a blast furnace which are the best on the basis of his unusually wide experience. JDG (6)

Relation Between the Angle of Inclination of the Flame and the Length and Width of an Open Hearth Furnace. M. S. Sokolov. *Domez,* No. 8, 1935, pages 25-27. In Russian. Based on published data concerning operating characteristics of open hearth furnaces the author finds that the relation between the width and length of a furnace must be equal to the sine of the angle of inclination of the flame, provided good fuel efficiency is desired. The sum of angles of inclination of gas and air ports is equal to the double angle of inclination of the flame. (6)

A Homemade Portable Assay Furnace. James P. Sloss & Tillman M. Patten. *Mining & Metallurgy,* Vol. 16, Nov. 1935, pages 451-452. The bricks are standard size, known as "G-25" brand made by A. P. Green Co., and weigh only 2 lb. Furnace is lined with ½" fire-clay splits weighing 1½ lb. each. Common adobe was used to fill joints. Use of adobe makes it possible to dismantle furnace quickly and preserve bricks. Cost of the furnace was about $9.50. Both fusing and cupelling can be done simultaneously. For heating a torch is used similar to those used to preheat large castings. Approximately ¾ gals. of gasoline is needed per hr. VSP (6)

Case-hardening and Heat Treatment in Salt Baths. C. Albrecht. *Engineering Progress,* Vol. 16, Dec. 1935, pages 311-312. For the heat treatment of Al alloys and drawing of steel, a bath of KNO_3 is employed heated to 580° C. Furnaces for this bath and also for cyanide baths are briefly described. Ha (6)

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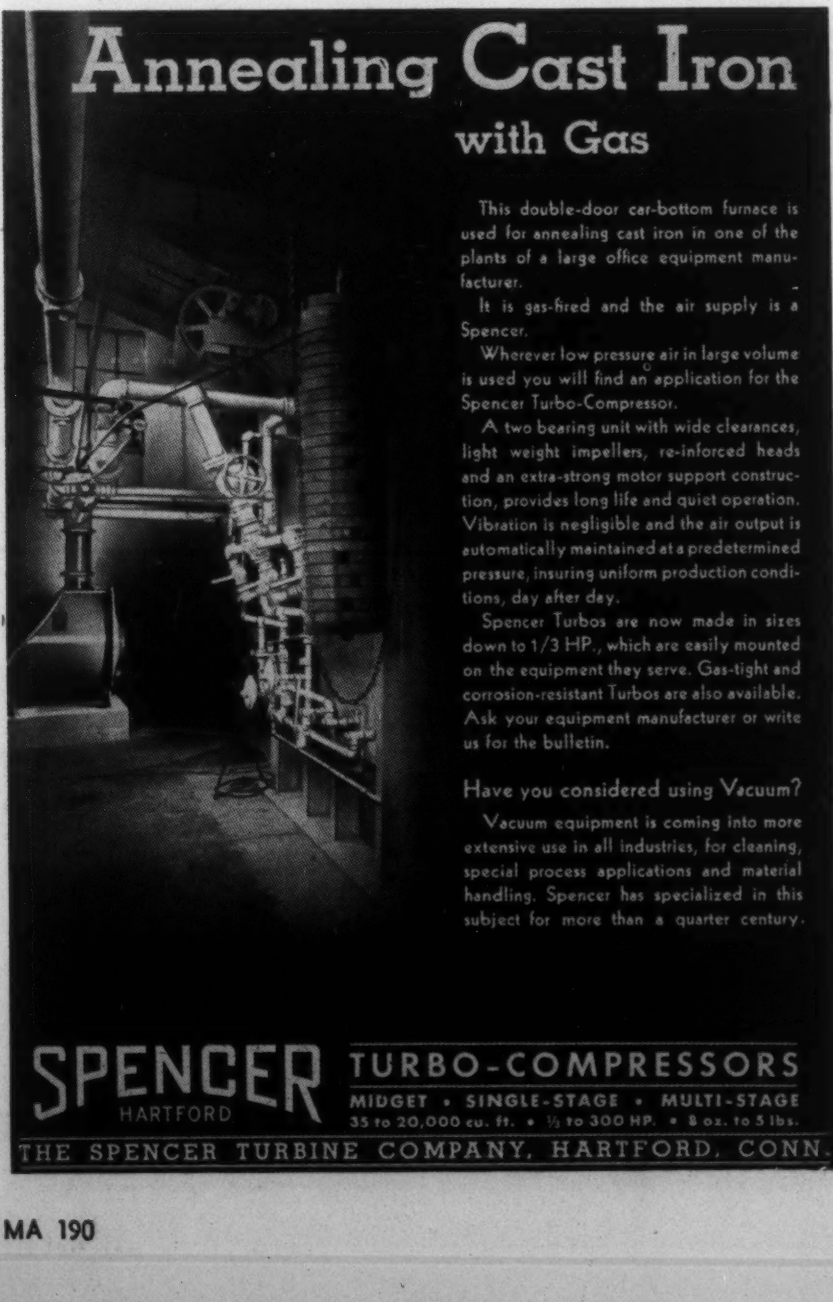
Roasting and Agglomeration of Dusts and Powdery Ores in a Turbulent Flow Furnace of Saint-Jacques Design (Le grillage et l'agglomeration des poussières et des minerais pulverulents dans le four à turbulence système Saint-Jacques) CAMILLE SAINT-JACQUES & LOUIS POUPET. *Revue de Métallurgie,* Vol. 32, Nov. 1935, pages 581-588. Loose material to be sintered is more or less heat insulating. Heating layers of it from one side requires a long time and much heat. In the present furnace dust is calcined in suspension in air and falls on the bottom in incandescent state so that it sinters. Furnace consists of a vertical steel container lined with firebricks. Flame is introduced at the bottom and at mid-height of the cylindrical furnace so that it moves along walls and escapes in the centrally located stack. Dust is blown in along the periphery of the stack so that it travels in a spiral along the walls in a counter current to the flame. Burning takes place instantaneously, and good sinter is formed. Mechanical details of furnaces in commercial operation are given. They are cheap, easy to operate and very economical as to fuel consumption. Furnaces can be used for simple calcining and for calcining in connection with sintering, such as for ores or cements. Several examples of results obtained on different materials are given. JDG (6)

Furnaces for the Heavy Forging Industry. HERBERT SOUTHERN. *Metal Treatment,* Vol. 1, Autumn 1935, pages 123-126, 131. Dimensional details are given of 7 producer-gas-fired furnaces for the new 7000-ton press at the Vickers Works of the English Steel Corporation. The construction of the largest (250-ton) furnace is illustrated and described in detail. Its heating chamber is 26 ft. 10 in. long, 17 ft. wide and 13 ft. high, and is equipped with a 450 ton bogie driven by a 50 h.p. motor. Figures of fuel consumption during 5 months' operation are given and shown to compare favorably with calculated quantities. JCC (6)

New Closed Furnaces for Making Aluminum (Nouveaux fours fermés pour la fabrication de l'aluminium) L. FERRAND. *Journal du Four Electrique,* Vol. 44, Oct. 1935, page 359. Points out that the furnace of his design, French patent 782,136, is better than the electrolytic cell provided with Soderberg electrodes described in June 1934 issue of the *Journal du Four Electrique.* JDG (6)

Continuous Mechanical Furnaces. J. FALLON. *Iron & Coal Trades Review,* Vol. 131, Dec. 20, 1935, pages 1024-1025. Heating and reheating units, factors affecting annealing, and conventional mill furnaces are discussed. The factors governing the design of continuous mechanical furnaces and the failures generally met with in operation in the various types of furnaces are described. Ha (6)

Graphite Resistor Radiation Furnaces and Their Application to High Temperatures. H. GEORGE. *Paper, Electrochemical Society,* Oct. 1935, pages 317-322. Describes a new type of furnace in which the heat is derived from graphite rods running axially (horizontally) through the cylindrical furnace shell. The rods are heated to incandescence by a current of 500 amps./cm.^{2} They radiate heat to the charge. Energy consumption is .8 kw./hr./kg. of steel at 1650° C. Resistor consumption is said to be less than that of arc furnace electrodes. Advantages are simple design, low first cost. Temperatures are limited by lining, i.e. up to 1800° C. By rotating the furnace the charge itself can be made to act as lining in which case up to 3000° C. is obtainable. GBH (6)



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7. JOINING

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

Torch Deseaming Removes Defects from Billets, Blooms and Slabs at Rate of 30 to 50 Feet per Minute. W. S. FARR. *Steel,* Vol. 97, Sept. 2, 1935, pages 38-40. Describes technique of using oxyacetylene deseaming equipment and method of handling steel. Torch deseaming insures removal of all defects and scrap, and results in savings in time and money. Steel should be preheated, space heated being as wide as practicable. When surface in immediate area of tip has reached sweating point, torch is drawn back and tip angle is reduced to about 20° with horizontal. After torch moves forward, cutting O_2 valve is opened wide. Light, fast cuts are best. Where adjacent cuts are required, first should be made nearest operator. Width of cut should be not less than 4 times depth with sides gradually sloping. Top of surface of steel should be about waist high. Proper turning of billets keeps them straight. O_2 pressure should be 60-90 lbs./in.^{2} and C_2H_2 pressure 8-10 lbs./in.^{3} MS (7b)

Largest All-Welded Ship. WALTER E. QUINE. *Metal Progress,* Vol. 28, Nov. 1935, page 66. Describes 259 ft. "Joseph Medill," all welded ship built in England for Great Lakes service. WLC (7b)

Service Records of Welded Ships Excellent. F. GRIMSHAW MARTIN. *Metal Progress,* Vol. 28, Sept. 1935, pages 51-53. Reviews the operating history of "Fullagar" all welded ship of 395 gross tons and concludes that such construction can be safely and economically employed for repairs and building of ships of this size. WLC (7b)

Self-Sharpening and Other Effects on Wear Resisting Metals. CHESTER MOTT. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, pages 26-28. A simple and lucid review of the properties of a tool most important for wear resistance. The requirements of hard-facing applications of weld-on type are analyzed from example of the simple case to its use in complicated wear conditions where the criteria may be cohesiveness, impact resistance, hardness, smoothness of deposit, thinness of welding, ability to scour. In various applications the order of importance of the variables may differ and the choice of the best hard-facing composition may be directed to a lower hardness with the other properties such that self-sharpening and permanence of facing are superior. WB (7b)

Shape-cutting of Locomotive and Car Parts. JAMES GRANT. *Welding Engineer,* Vol. 20, Dec. 1935, pages 34-36. Describes oxy-acetylene machine-cutting in railroad work. Ha (7b)

The Application of the Welding Rectifier to Thin-Plate Welding. N. A. HALBERTSMA, V. G. H. KERSTEN & E. S. WADDINGTON. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 97-104. Methods used for welding thin plates are described and the welds made are compared with those made by gas welding. JLG (7b)

The Metallurgy of Low-Carbon Metallic-Arc Weld-Metals. J. C. HODGE. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 391-417. Part I is an extended discussion of the metallurgy of welding. Part II is a discussion of the mechanical properties of welds at normal and elevated temperatures. Special attention is paid to the influence of N on strength and toughness. 25 references. JLG (7b)

Modern Methods of Welding. C. H. DAVY. *Welding Journal,* Vol. 32, Oct. 1935, pages 298-300, 309-310; *Industrial Chemist,* Vol. 11, Oct. 1935, pages 392-393. General account of papers read for Institution of Chemical Engineers. Author considers arc welding to offer only few more advantages than acetylene, but for plates ½" to ¾" thick joined in butt welding the arc gives lower cost. Not enough fatigue and corrosion data have been accumulated to predict the safety of the method for fabricating high temperature, high pressure equipment. For joining tubes the resistance butt weld is considered superior because no addition of metal from outside source is necessary, but for large tubes the necessary KVA capacity is increased to extremes. It is therefore restricted to tubes whose cross-sectional area to be welded is a max. of 30 in.^{2} Atomic H welding is considered supplementary to metal arc and not competitive, it is also considered not suitable for material greater than ½" thick but has advantage with thin sheets of stainless steels, and thin Al or dural, using a flux. RAW + WB (7b)

Resistance Welding of the Copper Alloys. IRA T. HOOK. *Welding Journal,* N. Y., Vol. 14, Oct. 1935, pages 20-25. Flash butt welding as used for Cu alloys is discussed. It is considered the ideal method for these metals in that the pressure is quickly and lightly applied while the metal is melted, thus preventing too great an upsetting effect. The order of good resistance weldability for the Cu alloys is approximately the reverse of the order of conductivity. Pure Cu is therefore not easily welded by resistance method, the modification of Cu resistance by alloying with Mn, Zn, Si, Ni is effective in producing resistance weldable metal. Mn is useful under 1½% as deoxidizer, desulphurizer and as slag forming element which forms a protective glassy flux in fusion welding, but in resistance welding this is of very little help except insofar as the deoxidizing and desulphurizing ability is concerned. Zn is most important as deoxidizer, strengthener and improver of ductility and resilience. Alloying with Zn reduces conductivity of Cu to easy weldability by resistance, while the volatilization of Zn on the other hand gives trouble in fusion welding. With higher Zn alloys, muntz metal and tobin bronze, the electrodes of resistance welder give trouble due to pick up of Zn. The role of other alloying constituents Si, Ni, Sn, P, Al, Be is discussed. Tables are given for Cu alloys with m. p., electrical and thermal conductivity, mechanical properties and evaluation of resistance weldability, also table of tests of resistance welds in Cu alloys giving % efficiency of welds in thin sheet material. WB (7b)

Welding in Marine Engineering. T. W. F. Brown. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 527-535. Discusses use of metallic-arc welding in marine engineering. JLG (7b)

Welded Steel Constructions in Poland in 1934. Stefan Bryla. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 47-53. Gives some details of design of buildings where welding was used. JLG (7b)

Tubular Steel Welded Constructions. Stefan Bryla. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 55-64. Discusses relative advantages of structures made by joining tubes by welding and describes several installations. JLG (7b)

Results of Tests with Rolled Beams Reinforced by the Aid of Welding. S. Bryla. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 689-701. Reports results of tests on ribbed girders and plate girders. JLG (7b)

The Volt-Ampere Characteristics of Arc Welding Generators. H. O. Burge. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 51-54. Illustrates the characteristics desired and tells how they are obtained. JLG (7b)

Arc Welding in a Steel Plant. W. H. Burr. *Electric Journal,* Vol. 32, Sept. 1935, pages 355-357. Improvement in welding machines during the last 25 years is traced. Utility in reducing maintenance costs and in the fabrication of materials is discussed. CBJ (7b)

Welding in Bridges. David Anderson. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 15-20. Brief description of bridge at Durham over River Tees and some welds used in its construction. JLG (7b)

The Welding of Structural Steelwork for Buildings. Ewart S. Andrews. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 21-22. Although welding of steelwork in buildings is now permitted in London no structures have been welded. JLG (7b)

Current Research Projects in Welding. W. Andrews & W. C. Welsh. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 307-316. Deals with the welding of chemical plant, particularly the welding of steels having a high strength at elevated temperatures. Developments in welding and of special steels must proceed together. JLG (7b)

A Modern All-Welded Bridge in Stockholm. D. Arvidsson. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 31-42. Engineering description of the bridge. JLG (7b)

Notes on the Welding Practice in British Warships. Director of Naval Construction. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 67-77. Discussion of the subject. JLG (7b)

The Influence of Welding on the Design of Steel Construction. C. Helsby, C. W. Hamann & J. F. Samuely. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 117-126. Shows why designs for riveted structures are not the most suitable for welded structures. JLG (7b)

Electric Arc Welding in Shipbuilding. J. L. Adam, N. M. Hunter, S. B. Ralston, E. W. Russell & H. W. Townshend. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 357-374; *Transactions Institute of Marine Engineers,* Vol. 47, July 1935, pages 115-163. Review giving indication of use being made of arc welding in shipbuilding at present and discussing principal technical problems that have to be met in designing merchant ships suitable for welding. 13 references. JLG + WH (7b)

The Welding of Boiler Drums and Other Pressure Vessels. C. H. Davy. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 205-214; *Steam Engineer,* Vol. 4, July 1935, pages 435-437. Discusses welding technique and inspection. JLG + AHE (7b)

Experiments to Determine Welding Stresses. G. M. Shaw & L. C. Percival. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 897-910. Gives results of tests made on gas and arc welds. JLG (7b)

Experimental Welding and Stress Measurement in Connection with Ship Construction. G. M. Shaw. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 879-895. Gives results of experiments made to determine the properties of welds made in construction of ships. JLG (7b)

Note on the Use of the Tensometer in Detecting Variability of Weld-Metal. L. W. Schuster. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 569-572. Gives some results obtained from small tensile samples cut from welds. JLG (7b)

Some Important Considerations in the Preparation of a Specification for a Welded Boiler. L. W. Schuster. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 867-877. Discussion of the subject. JLG (7b)

Welding in Building and Bridge Work. Schaper. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 173-174. Deals with design and safety of welded structures. JLG (7b)

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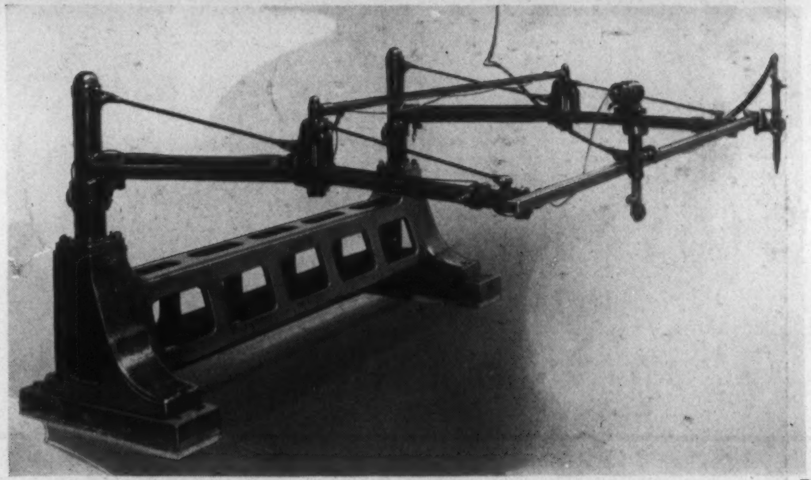

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Standard Specifications for Arc Welding Structural Steel for Buildings. A. VOGEL. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 925-928. Gives some American specifications that have been used. JLG (7b) 1

Bronze Welding. C. H. S. TUPHOLME. *Metal Industry,* London, Vol. 46, Apr. 19, 1935, pages 431-432. The author attributes to a recently developed non-ferrous welding rod, suitable for both ferrous and non-ferrous materials, the progress recently made in the act of joining metals by welding. This is largely due to the carefully balanced reducing agents in the rod which reduce the loss of Zn during welding, prevent the formation of gases and oxides, and produce an oxide-free, non-porous weld metal of maximum physical properties and of excellent machinability. Advantages claimed are (1) that heat of application required is low so that speed is increased, (2) that only local preheating is necessary, (3) that it can be used for building up worn parts without producing distortion, (4) that dissimilar metals may be welded. Applications that are outlined include cast Fe, steel and wrought Fe, and Cu. HBG (7b) 2

Welding Practice and Technique Employed in the Construction of Deep Sea Trawlers. H. W. TOWNSHEND. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 197-203. Discusses welding practice. JLG (7b)

Welding of the High Chromium-iron Alloys Used for Heat and Corrosion Resistance. ERNEST E. THUM. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 603-616. Discusses practices and tests used in the United States. JLG (7b) 3

Results of Ten Years of Practical Experience in the Arc-Welding of Fan Wheels for Blowers and Dynamo Electric Machines. G. ZERIALI. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 609-618. A review. JLG (7b)

Welding Fine Wires. O. ZDRALEK & J. WRANA. *Electrical Review,* Vol. 116, June 21, 1935, page 898. From *Elektrotechnische Zeitschrift,* Vol. 56, May 23, 1935, pages 379-380. See "Welding of Wires by Condenser Discharges," *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 452L/6. MS (7b) 4

Thyratron Control of Resistance Welding. A. L. WHITELEY. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 205-212. Describes the Thyratron and how it is used in spot and seam resistance welding. Shows results obtained in welding stainless steel. JLG (7b)

Eye Protection in Welding. W. WATSON. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 929-933. Discusses color of glass and construction of frames. JLG (7b) 5

Welding in the Heavy Industries Including Marine, Railway and Structural Plant. P. WRIGHTSON & R. WARRINER. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 605-608. General discussion. JLG (7b)

Welding in Aircraft Construction. H. SUTTON. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 449-458; *Aircraft Engineering,* Vol. 7, July 1935, pages 178-180. Lists cases where welding is allowed in construction of English aircraft and gives test results on some welded structures. All important joints must be annealed after welding. Research work in progress is mentioned. JLG + WB (7b)

The Need for Standardisation and Uniform Thought in Welding Subjects. O. SIMONIS. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 911-914. Points out need for uniformity in discussion of welding and for standardized materials for welding. See also *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 402L/4. JLG (7b)

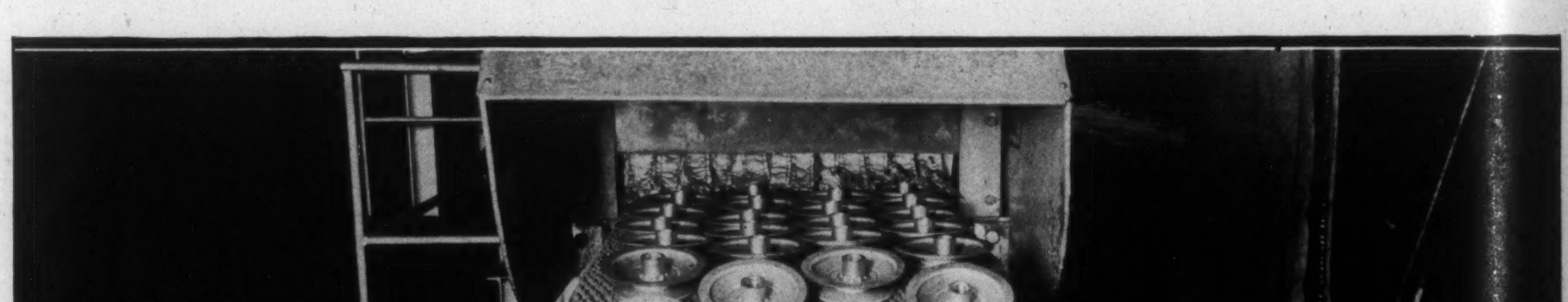
Application of Arc Welding to Construction and Maintenance of Rolling Stock. J. M. ASHWORTH & H. N. MAY. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 299-306. Describes use of welding by railway in Australia. JLG (7b)

New All-Welded Construction System Is Applied to Small Tankship. *Steel,* Vol. 97, Oct. 7, 1935, page 34. Principal feature of "free flow frame system" developed by Johannes Kjekstad is that the framing is set off from the shell plating by some 2" and is secured to it by welded lugs at regular intervals. Design achieves greater strength, lighter weight, elimination of detrimental stresses and distortions, and economies in maintenance and repair. MS (7b)

The Welding of Cast Iron: Some Metallurgical Considerations. J. G. PEARCE. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 463-470. Gives reasons why cast Fe is difficult to weld and tells conditions necessary for successful welding. See also *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 402R/1. JLG (7b)

Sound-repair of Steel Castings by Welding. A. M. ROBERTS. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 635-645. Gives detailed directions for repairing steel castings by metallic-arc weldings. Defects are frequently surrounded by segregated metal that is hot-short and caution must be used to prevent cracking as the weld-deposited metal cools. JLG (7b)

Welded Rolling Stock of the Norwegian State Railways. MAGNUS MOE. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 331-337. Describes application of welding by Norwegian railways. Welded underframes and cars have been made. JLG (7b)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Products ranging from small radio tube parts to heavy automotive and refrigerator units are neatly and economically joined in brazing furnaces built by The Electric Furnace Co., Salem, Ohio. It might pay to investigate this process for joining your products.

Welding Fabrication for Heavy Engineering. E. C. Moore & T. A. Swindell. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 583-589. A review of practice at an English plant. JLG (7b)

Ship Welding Developments. G. H. Moore, Jr. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 375-384. Observations on the general status of welding in shipyards, particularly American yards. Welding is firmly established. 22 references. JLG (7b)

Comparison of Electrically-welded Chains and of Chains Made from Wrought Iron. Vaclav Nápravník & Stepán Popov. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 513-526. Tensile and impact test results are given for resistance-welded and pressure welded chains made from wrought Fe and from soft steel. The data show that the properties of resistance welded steel chain are better than those of resistance-welded or pressure-welded wrought Fe. Pressure-welded wrought Fe chain was less apt to be defective than pressure-welded steel chain, but resistance-welded steel chain had the least tendency to be defective. JLG (7b)

Welding in the Chemical Engineering Industry. N. P. Inglis & W. Andrews. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 259-265. Reviews use of C and stainless steels welded for use in chemical industry in England. See also *Metals & Alloys*, Vol. 6, Oct. 1935, page MA 402L/9. JLG (7b)

Welding Practice and Technique in the Construction of Ships of Moderate Size. N. M. Hunter. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 115-118; *Welding Journal*, British, Vol. 32, June 1935, pages 184, 188. Discussion of the subject. See also *Metals & Alloys*, Vol. 6, Nov. 1935, page MA 452L/5. JLG + WB (7b)

Some Experiments to Ascertain the Effects of Strengthening Girders by Welding. G. Ellson. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 759-769. Gives results of tests on small pieces of material, on strengthening of joints by addition of flange plates, on strengthening of plate girders by adding strips to the flanges, and of strengthening of the web of a plate girder by adding a plate in an end bay. JLG (7b)

British Railway Welding Practice as Applied to Permanent Way and Bridge and Structural Repair Work. G. Ellson & J. Miller. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 307-330. Describes repair work on worn crossings and many repairs and strengthenings of structures by welding. JLG (7b)

Specification for Electrodes for Use on Mild Steel Bridge Work on the North-Western Railway, India. W. T. Everall & P. S. A. Berridge. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 777-782. Gives specification used by North-Western Railway of India. JLG (7b)

Specification for Metallic-Arc Welding as Applied to Mild Steel Bridge Work on the North-Western Railway, India. W. T. Everall & P. S. A. Berridge. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 783-790. Gives specifications used by North-Western Railway of India. JLG (7b)

Report on the Experiments Carried Out on Riveted Joints Strengthened by Electric Arc Welding. W. T. Everall & P. S. A. Berridge. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 771-775. Gives results obtained on specimens resembling the connections between gussets and web members of a triangular girder. Tests were made to determine the distribution of stress between the original rivets and the newly applied weld fillets. JLG (7b)

Welded Steel Bridges of the German State Railways (Geschweisste Stahlbrücken der deutschen Reichsbahn). A. Dörnen. *Zeitschrift Verein deutscher Ingenieure*, Vol. 79, Oct. 12, 1935, pages 1264-1268. The German State Railway administration has recognized welded structures as fully equivalent to riveted structures with regard to safety. Admissible stresses, designs, welding methods applied, and savings obtained are discussed and examples described. Ha (7b)

Welding Practice and Methods of Avoiding Distortion in Welded Structures. J. A. Dorrat. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 79-87. Discusses some of the factors tending to produce distortion and gives methods used by an English manufacturer of electrical equipment for avoiding distortion. JLG (7b)

Application of Electric Welding in the Fabrication of Plant and Machinery. J. A. Dorrat. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 557-564. Discusses metallic-arc welding as applied to manufacture of heavy electrical machinery. JLG (7b)

The Use of Welding in Large Civil Engineering Constructions in Belgium. H. Dustin. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 67-77. Discussion of welding in reinforced concrete and in construction of new bridges. JLG (7b)

Inspection and Testing Procedure—with Special Reference to Welded Pressure Vessels and Engine Entablature. S. F. Dorey. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 745-758. General discussion of inspection and testing. JLG (7b)

Welding Practice in Australian Automobile Manufacture. F. S. Daley. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 489-502. A review. JLG (7b)

Construction and Repair by Arc Welding. A. F. Davis. *Welding Journal*, N. Y., Vol. 14, Oct. 1935, pages 2-7. A review with photos and discussion of a series of remarkable welding jobs for land and sea service performed by arc welding. WB (7b)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Finishing Console Heaters. Orrie D. Maal. *Industrial Finishing*, Vol. 12, Nov. 1935, pages 28, 32. Deals with cleaning and finishing high-grade console gas heater and floor register grilles made of steel. Console cabinets are made of smooth cold-rolled, beveled steel and legs are cast Fe. They are baked at 400° F. After prime coat has been applied it is baked at 390° F. for ½ hr. The final coat is baked at 260 to 275° F. for 2 hr. Grilles for registers are finished the same way. VSP (8)

Finishing Steel Bodies for Commercial Cars. Kam N. Kathju. *Industrial Finishing*, Vol. 11, Oct. 1935, pages 28, 33. Suggestions and recommendations based on the author's observations and experience in the automotive field. VSP (8)

8d. Electroplating

Tin Coating of Galvanized Steel Sheets. A New Method of Improving Galvanized Steel Sheets (Zur Verzinnung galvanisierter Stahlbleche. Ein neues Verfahren zur Veredlung von galvanisierten Stahlblechen). Ralph W. Harbison. *Die Metallbörse*, Vol. 25, Aug. 10, 1935, page 1011; Aug. 17, 1935, page 1043. In the introduction, a lengthy discussion on the shortcomings of Cd plating in comparison with the galvanizing process is given and the latest advancements, including the author's own experiences, in the Sn coating of galvanized steel sheets are discussed. EF (8d)

Defective Chromium Plating, Its Determination and Elimination (Mangelhafte Verchromungen, ihre Bestimmung und Entfernung). Ralph W. Harbison. *Metallwaren Industrie & Galvano Technik*, Vol. 33, Dec. 15, 1935, pages 521-522. Considers mainly the dipping test in $CuSO_4$, the ferroxyl method, and the electrolytic test for faulty Cr platings, the last being considered the most reliable. The removal of defective Cr coatings on Fe, steel, Cu, brass and bronze by the electrolytic method is recommended. EF (8d)

Sulphuric Acid Determination in Chromium Plating Solutions (Die Schwefelsäurebestimmung in Chrombädern). M. Günthel. *Metallwaren Industrie & Galvano Technik*, Vol. 33, Apr. 1, 1935, pages 139-142. Results of extensive experiments on determining H_2SO_4 in Cr plating solutions to which Fe, Al, Cu, Zn, Sn, Ni, Tl, Cr, Cd, Mn, Ca, Bi and Sb salts were added. The contents of CrO_3 and H_2SO_4 varied over a wide concentation range. EF (8d)

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Utilization of Electro-Graphical Accelerated Methods for Testing Metal Coatings (Anwendung der elektrographischen Schnellmethoden zur Prüfung galvanischer Überzüge). ALEXANDER GLAZUNOW. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Aug. 15, 1935, pages 347-349; discussion, Nov. 15, 1935, page 482. The electro-graphical determination developed by the author is based on electrolysis and represents the reversed process of electrode position (cathodic) of metal. In this testing a piece of paper soaked in a certain reagent which reacts with the metallic ions of the coating is used. The article discusses the qualitative test for Cu, Au, Al, Pb, Cd, Cr, Fe, Co, Ni, Ag, Sn and Zn. Several reagents are given for several of these coatings. The second part of the article considers the possibilities of quantitative determinations and states that the method has been successfully applied in the determination of Ni in Ni-steels but that it has not been adapted yet to testing metallic coatings. EF (8d)

Our Experience in Cadmium Plating in a Barrel. A. F. FLETCHER. *Monthly Review American Electroplaters' Society,* Vol. 22, Sept. 1935, pages 32-38. An effort was made to study the most efficient conditions of operation in a Cd plating barrel. GBH (8d)

Electroplating Zinc Base Die Castings. C. H. COSTELLO. *Monthly Review American Electroplaters' Society,* Vol. 22, Sept. 1935, pages 14-23. The surface of die castings is prepared by grinding successively with 120, 180, 200 emery, and then buffing. As little metal as possible is removed during grinding because the surface layer is the most dense and cutting through it may expose porous areas. Cleaning is as follows: (a) washing in an organic solvent (carbon tetrachloride, benzene, naphtha) or a vapor degreaser; (b) electrolytic alkaline cleaning in a 2 to 6-ozs./gal. solution of tri-sodium-phosphate or sodium metasilicate, at 200° F., with the specimen as cathode, at 6 volts pressure; (c) thorough rinsing in hot and then in cold water is followed by an acid dip in either HF (1 to 5% by vol.) or H_2SO_4 (5%), results in each case being about the same; (d) rinsing. Plate in cyanide solution containing: Cu 2.5 to 3.5; free cyanide .5 to .75; carbonate 5 max. ozs./gal., 100°-115° F., 12-15 amps./ft.^{2} Free cyanide must be low to prevent blisters. A good ratio is 5 parts Cu to one of free cyanide. Ni can be plated directly on die casting in a solution of single Ni salts 8; anhydrous Na sulphate 12; NH_4Cl 3; and boric acid 2 ozs./gal., pH 5.8. If articles are not deeply recessed more concentrated solution can be used and consequently higher current densities. The more complex the shape of the piece the greater should be the amount of Na sulphate. GBH (8d)

Report of Research Work on Electrodeposition at the National Bureau of Standards. W. BLUM & P. W. C. STRAUSSER. *Monthly Review American Electroplaters' Society,* Vol. 22, Sept. 1935, pages 10-18. An itemization of work recently completed and in progress at the Bureau of Standards, including specifications and tests of plated coatings, rapid Ni and Fe plating, and preparation and examination of specimens for exposure tests. GBH (8d)

Chromium Plating. United Chromium vs. General Motors Corp., The New Departure Mfg. Co., The Bassick Co. *Monthly Review American Electroplaters' Society,* Vol. 22, Sept. 1935, pages 19-31. Decision by Judge D. J. Thomas is reprinted. Conclusion is that defendants have infringed upon Fink patent No. 1,581,188 issued Apr. 20, 1926. GBH (8d)

Bright Electrodeposits of Nickel in the Presence of Colloids (Erlangung glänzender Nickel-Elektrolytniederschläge bei Gegenwart von Kolloiden) *Metallwaren-Industrie & Galvano-Technik,* Vol. 33, Mar. 1, 1935, pages 97-98. The lustre of Ni-platings obtained in a bath of 100 g./l. $NiSO_4 + 7\ H_2O$, 9 g./l. NH_4Cl, 12 g./l. $(NH_4)_2SO_4$ at 40° C., 4 amps./dm.^{2} in 26 min. was determined by means of photoelectric cells. Addition of Na_2SO_4 results in larger brighter areas due to the reduced tendency to flocculation of the colloidal regions in the basic Ni-salts. Additions of 0.1-0.2 g./l. Cd to a $NiSO_4$ electrolyte yield brighter deposits at a pH value of 6.8 and at reasonably high voltage. The Ni-deposit contains 0.3-1.64% Cd. It is assumed that Cd assists the formation of colloidal compounds at the cathode. At low voltage, the Ni-deposits are discolored. In a more acid electrolyte, small black Cd-rich (up to 13% Cd) "pimples" occur. Many organic colloids including starch, dextrin, gum arabic, agar-agar, gelatine, albumin, casein furnish uniformly bright Ni coatings. Certain colloids are more effective at low concentrations, as for instance gelatine with 2.5 mg./l. at pH = 6.5. The same effect is obtained at pH = 8.0 with 0.4 g./l. gelatine. With added organic colloids, the cathodes are bright over a large range of voltage. When the colloids are formed at the cathode during electrodeposition, the luster of the coating depends strongly on the current voltage and is uniformly bright only in exceptional cases. EF (8d)

Nickel and Chromium Plating of Galvanized Iron Sheets and Zinc Die-Castings (Vernickelung und Verchromung von Zinkblech und Zinkspritzguss) T. BRAUTMANN. *Metallwaren-Industrie & Galvano-Technik,* Vol. 33, Mar. 15, 1935, pages 119-120. The pretreatment of Zn and Zn die-castings for electro-plating is the same as for other materials. Treatment consists of electrolytic degreasing solution containing 45 g./l. tri-Na-phosphate (boiling temperature, high current densities, 1-2 min. duration) followed by rinsing with hot water, then with cold water. There are 2 approved Ni-plating processes: one uses an intermediary layer of Cu (or brass) and is widely utilized for galvanized sheets. Bath contains 20 g./l. of each of the following chemicals: Cu-acetate, Na_2CO_3, Na-bi-sulphate, KCN. Time: 15-min.; temperature: 15°-20° C., current density: 0.3-0.4 amps./dm.^{2}; voltage: 3.4 volts; electrode distance: 15 cm. Electrolytes used for direct Ni-plating are suitable but the initial current densities should be lower. The second process is a direct plating process. The principal requirement of Ni-plating solutions for Zn is a low-ion concentration otherwise Zn will go in solution and a black Ni-deposit be produced. $NiSO_4$ and Ni-citrate are added individually or together. The former is conducive to high conductivity and throwing power. Bath composition in g./l. H_2O: 75 ordinary Ni-salt, 75-100 $NaSO_4$, 15-23 NH_4Cl, 75 boric acid. pH = 5.8-6.2. 20°-25° C. bath temperature, initial (1-2 min.) and regular current densities are 3.2 amps./dm.^{2} and 1.3-1.9 amps./dm.^{2} respectively. Data on current and plating time are given with reference to a 0.0075 mm. deposit. Cr plating on Zn can be accomplished only with an intermediary layer of Ni. EF (8d)

Chromium Plating Without Intermediary Layer of Nickel (Verchromung ohne Untervernicklung) *Metallwaren Industrie & Galvano Technik,* Vol. 33, June 15, 1935, pages 256-258. Mainly discusses the suitability of intermediary layers of Cu. EF (8d)

Builders' Hardware in New Sales-Appeal Finishes. Ernest J. Nettel. *Industrial Finishing,* Vol. 10, Sept. 1934, pages 24-29. New finishes in colored lacquer and in Cr plating are used on such items as padlocks and night latches. JN (8d)

Black Nickel. J. L. Downes. *Monthly Review American Electroplaters' Society,* Vol. 22, Aug. 1935, pages 17-22. The black Ni plating solutions, 2500 gallons, used on typewriter parts consists of $NiSO_4$ 10, Ni ammonium sulphate 6, $ZnSO_4$ 5, and Na sulphocyanate 2 ozs/gal. Another solution for producing a "smut" that can be "relieved" to obtain a French Gray finish contains Ni ammonium sulphate 15, $CuSO_4$ 5, NaCl 96, and 26° Bé ammonia 18 oz./3 gal. Black Ni differs from other electrodeposits in that it is not 100% metal. Good black Ni will analyze, in part, Ni 52%, Zn 7.5%, and S 14%. A poor deposit will show Ni 40%, Zn 10%, and S 7%. It has been found that control of the S content is most important. Black Ni is not rust proof and preferably should be applied over a white Ni deposit. Conditions of operation of the solution first described are, temperature 65°-78° F., voltage 1½-2, current density/ft.^{2} 1-1½, pH 6.6-6.8. Low temperature causes poor distribution, high temperature a lighter or gunmetal color. High voltage results in burned or gray deposits. pH lower than 6.0 gives light color and soft deposits. This installation is a semi-automatic conveyor with cathodes traveling 20"-25"/min. GBH (8d)

The Structure and Properties of Nickel Deposited at High Current Densities. William Blum & Charles Kasper. *Transactions of the Faraday Society,* Vol. 31, Part 9a, Sept. 1935, pages 1203-1211; *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, May 3, 1935, pages 489-491. A discussion of the structural and mechanical properties of some of the Ni deposits produced in an investigation of a more rapid deposition of Fe and Ni. This is a study of electrodeposition at current densities of at least 20 amp./dm.^{2} in the endeavor to obtain Ni that was ductile, free from strains, of comparatively smooth surface, and free from pits. The necessary exploratory experimental work, the quantitative tests, operating conditions and methods are described together with the results obtained and the effects of each variable. The authors' conclusions emphasize the necessity for a more exhaustive study of the deposition of Ni (and other metals) and the need for more discriminating methods of examining deposits. 14 references are appended to the original paper. HBG (8d)

Modern Methods of Electroplating. *Industrial Chemist,* Vol. 11, Sept. 1935, pages 343-352. A description of Cr plating in the Osberton Works of Morris Motors Limited. Plant layout and operation of mass production methods are described. RAW (8d)

Saving of Tin by Tin Plating (Zinnersparung durch elektrolytischen Niederschlag) *Metallwaren Industrie & Galvano Technik,* Vol. 33, Dec. 1, 1935, pages 502-505. Hot dipped Sn coatings on cans correspond to 43-82 g. Sn/m.^{2}, while 10-15 g./m.^{2} afford sufficient protection. The maximum amount required is 30 g./m.^{2} in the case of fruit acids. The relative merits of both Sn coating methods are discussed critically and a historical review of various electrolytes proposed (10 methods) is given. The remarkable development of machinery for automatic electrolytic Sn coating processes as the greatest contributing factor in the advance of Sn plating is stressed. EF (8d)

Nickelplating and Chromiumplating. Progress and Present Situation (Nickelage et Chromage, Progrès et Situation actuels) M. Ballay. *Usine,* Vol. 44, Nov. 14, 1935, page 27. A brief review of practices in different countries. Ha (8d)

Electro-Graphical Testing of Porosity of Metallic Coatings (Elektrographische Prüfung der Porosität metallischer Überzüge). A. Glazunow & J. Teindl. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Aug. 15, 1935, pages 371-372. Comparison of testing methods and the authors' new electrographical test. The latter is carried out in a few seconds. Its application to the following 2 cases is discussed at length: (1) when the coating has a higher potential than the underlying metal and (2) when the carrier is nobler than its protective coating. EF (8d)

■ 8e. Metallic Coatings other than Electroplating ■

Metal Spraying in the Finishing Industry. J. C. Bowen. *Synthetic & Applied Finishes,* Vol. 6, Oct. 1935, pages 161-162. Sprayed Zn coatings are employed very extensively in the manufacture of cellulose acetate. The purpose is not so much to prevent corrosion as to prevent discoloration of the product due to contact with steel. Al-sprayed mild steel storage tanks for cellulose lacquer are used by furniture manufacturers for the same reason. Sprayed Pb coatings are used chiefly for acid resistance. The combination of sprayed Al coatings and synthetic resin varnish is being used for the protection of steel fuselages of seaplanes against corrosion. A new process has been announced for the deposition of "hard" metals such as Ni, of plain C and stainless steel and for the building up of worn machinery. EF (8e)

Galvanizing Defects on Steel Sheets Because of Defective Base Material (Verzinkungsfehler auf Stahlblechen infolge mangelhaften Kernwerkstoffes) M. von Schwarz & H. Fromm. *Korrosion & Metallschutz,* Vol. 11, Nov. 1935, pages 241-245. The investigation into the causes of defective galvanizing was extended in particular to sheets which had been pickled in HCl, galvanized in vertical position in a Zn bath containing a little Al, and the influence of the various microstructural features due to C on the quality of the galvanizing was studied. It was found that the more completely the C was precipitated in low carburized sheets during annealing as grain-boundary cementite, the better and more uniform was the galvanizing, and the galvanizing was inferior where pearlite occurred along with the grain-boundary cementite. This was attributed to the action of the H which penetrates during pickling into any discontinuities in the grain structure and is driven out again by the heat of the galvanizing bath and thus disturbs the crystallization of Zn. The highest possible uniformity and cleanliness of the sheet surface is necessary for good Zn coatings. Ha (8e)

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Surface and Underground Transportation Companies Save. D. A. Wilson. *Metallizer,* Vol. 3, Oct. 1935, pages 5, 15. Applications of metal spraying in the transportation industry include salvaging of split motor bearings by spraying bronze on the bearing surface and resurfacing; building up worn armature shafts with medium C steel after rough machine turning; coating rail ends, connecting plates and rail bolts with Cu or Zn; rebuilding thrust collars; Zn-coating supports for elevated lines and bridges; spraying Al or bronze on walls and ceilings of freight elevators; Pb spraying battery boxes; and rebuilding of worn car axles, crank shafts, etc. BWG (8e)

Metallizing New Refinery Vessels. G. M. Jackson. *Metallizer,* Vol. 4, Nov. 1935, page 11. All of the 21 large condensers for a new oil refinery in California are being coated with Pb on all interior surfaces. An average of 2 lbs./ft.^{2} is applied, with wire brushing after every 2 coats. A liquid after-coating is applied to protect the Pb while a Pb sulphide surface coating is forming. Metal spray Al coatings are specified for the protection of the interiors of flash towers and fractionating columns. BWG (8e)

Protecting Floating Roofs of Oil Tanks. R. A. Axline. *Metallizer,* Vol. 4, Nov. 1935, pages 9-10. Metal sprayed coatings can be successfully used for protection of roofs of oil and gasoline storage tanks. Pb is the only suitable coating. A minimum thickness of 0.020" is necessary and a thickness of 0.030" is advocated for assurance of long life. BWG (8e)

Formation of Hard Zinc (Dross). (Hartzinkbildung) H. Meyer auf der Heyde. *Oberflächentechnik,* Vol. 12, Sept. 17, 1935, page 222. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 500L/7. Ha (8e)

Tinning Rustless Steel (Verzinnung von rostfreiem Stahl) *Montanistische Rundschau,* Vol. 27, Nov. 16, 1935, page 5. Rustless steels may be tinned with a Sn-Pb solder containing 50-65% Sn. The surface must first be cleaned with 50% HCl; a saturated solution of $ZnCl_2$ in 50% HCl is used as flux. If the surface of the steel has a high polish it should first be roughened with emery paper or etched for 10-15 min. with a solution containing 50 parts of $FeCl_3$ in 100 parts HCl. BHS (8e)

Coating of Steel with Eutectic Cd-Zn (Revêtements à chaud de l'acier avec l'eutectique Cadmium-Zinc). Giuliano Montelucci. *Métaux,* Vol. 9, Oct. 1934, pages 509-519. 20 references. Eutectic Cd-Zn (83% Cd and 17% Zn) which melts at 266° C. was used for coating aircraft steels. This alloy adheres firmly to steel. The Brinell hardness (2.5 mm. ball and 62.5 kg. load) as compared with that of Zn and Cd is as follows: Eutectic Cd-Zn 51.5, Zn 43.5, and Cd 17.8. The eutectic is prepared by heating the mixture to 350° C. sufficiently long to insure a thorough mixing of metals, then lowering the temperature to about 280° C. Steel wire was coated by immersion in this molten metal bath. The bath was covered with Zn and ammonium chloride salts. Cd-Zn eutectic coating was compared with other types of coatings and the mechanical and corrosion tests indicate the Cd-Zn coating to be superior. Other coatings tested were: Zn, Sn, Pb, Sn-Zn, Al-Cd. Eutectic Cd-Zn can also be successfully applied by metal spray. GTM (8e)

8f. Non-Metallic Coatings

Mechanics of Enamel Adherence, XI Application of the Theory of Dendritic Adherence to the Development of White Ground Coats for Sheet Steel. W. L. Housley & R. M. King. *Journal American Ceramic Society,* Vol. 18, Oct. 1935, pages 319-320. The investigation was undertaken to find a white oxide which would aid in forming dendrites in the same manner that Co and Ni oxides do at the enamel-Fe interface. A quick qualitative test was first used, giving negative results with Cr_2O_3, As_2O_2, CdO, Bi_2O_3, ZnO, PbO, SnO_2, Sb_2O_3, Na-uranium salt, U_3O_8, CuO, Cu_2O and positive results with MoO_3, WoO_3. X-ray patterns of these enamels were obtained. The cause of good adherence of enamel to sheet Fe is considered to be the precipitation of Fe at the enamel-Fe interface which is greater with Sb_2O_3-MoO_3 enamel than for the enamel with Sb_2O_3-WoO_3. WB (8f)

Finishing Products Made of Steel, Wood and Die-Cast Alloy. Eugene Lewis. *Industrial Finishing,* Vol. 11, Nov. 1934, pages 9-10. The author describes the successful use of the same paint applied simultaneously with the same procedure to 3 types of surfaces, namely: steel; wood; and die-cast alloy, in finishing small home ironing machines. JN (8f)

Graining and Marbleizing Steel Burial Vaults. George Moskos. *Industrial Finishing,* Vol. 10, Aug. 1934, pages 14-16, 18. A description of prime-coating, ground-coating, and hand-graining steel burial vaults with water colors to imitate Circassian walnut, mahogany, American walnut and grained marble. JN (8f)

Coating and Decorating Tin Plate. J. W. McHugh. *Industrial Finishing,* Vol. 10, Oct. 1934, pages 15-16, 18, 20. Description of the coating, printing, varnishing and lacquering processes for Sn plate used in the manufacture of food containers with a discussion of the raw finishing materials involved. JN (8f)

Automobile Refinishing. A. W. Venzke. *Industrial Finishing,* Vol. 10, Aug. 1934, pages 27-28, 30. The refinishing of high-grade cars requires the thorough cleaning of all parts and the removal of all old finish. A coat of metal primer is followed by 2 to 4 coats of surfacer. The surface is then sanded off and wiped. Two to 4 coats of colored lacquer enamel are then applied, followed by wet-sanding, then by 2 more coats of color and one coat of thinner. The job is finally rubbed by hand and waxed. JN (8f)

Opacity Development in Cover Enamels for Sheet Steel. James D. Tetrick. *Journal American Ceramic Society,* Vol. 18, Oct. 1935, pages 314-318. Tests were made on several enamels using SnO_2 or Na-antimonate or both as opacifiers alone or in combination with cryolite and fluorspar. Various gages of base metal were tested with the enamels for firing time and temperature. Results, given in tables and curves for reflectance data, are discussed. Full gloss of enamels is obtained before full opacity during firing; increased firing temperature develops opacity at faster rate but max. is not higher. Gage of metal affects rate and degree of opacity; light gage gives faster rate and higher degree than heavy gage, but firing on cold points does not give this difference for light and heavy gages for degree of opacity. Coarse milling retards rate of opacity development as well as degree of opacity obtained. Increase in opacity during early period of firing is not characteristic of any one opacifier. It is characteristic of enamels containing each opacifier individually and in combination. More refractory cover enamel, heavier gage of base metal and to a lesser extent coarse milling of the enamel, retard the rate of opacity development during freezing. A cover enamel containing fluorides, 8% Na-antimonate in the melt produces a degree of opacity equivalent to 6% SnO_2 in the mill charge, showing superiority of SnO_2 over either Na-antimonate or fluorides. WB (8f)

Aluminum Paints (Aluminiumanstriche). Berthold Winter. *Montanistische Rundschau,* Vol. 27, Nov. 1, 1935, page 12. Al paint is used to rustproof iron. Can stand temperatures up to 1000° C. without tarnishing. Is widely used on tanks for volatile liquids because it reflects about 70% of the sun's rays, thus cutting down evaporation losses. A coating of Al on wood protects it from rot. Resists NH_3 and is therefore widely used for painting machinery and equipment in refrigeration plants. Also resistant to H_2S. Interesting color schemes are possible by addition of pigments to the Al powder. BHS (8f)

Graining on Metal. Armin Furrer. *Industrial Finishing,* Vol. 11, Dec. 1934, pages 15-16. Discusses imitation wood finishes on metal and describes a process for producing a hand-grained walnut finish. JN (8f)

A Study of Furnace Atmospheres and Temperature Gradients and Their Effect on Porcelain Enameling. H. E. Ebright, G. H. McIntyre & J. T. Irwin. *Journal American Ceramic Society,* Vol. 18, Oct. 1935, pages 297-302. A method of analyzing muffle furnace gases is described and determinations shown for a number of runs made under ventilated and non-ventilated conditions. The temperature gradients in the continuous furnace, determined for ventilated and non-ventilated conditions, are shown in curves. Moisture content of 10% by volume in firing zone usually causes blistering, copperheading and poor surface texture in wet-process enamels. Other gases producing acid conditions in firing zone also have bad effect on enamel. Copperheading, when caused by excessive oxidation of metal before fusion of ground coat can be avoided by lowering preheat zone temperature. WB (8f)

Cleaning and Bake-Finishing Automotive Parts. J. B. Nealey. *Industrial Finishing,* Vol. 12, Nov. 1935, pages 17-18, 20, 22. **Japanning Costs Reduced by Gas Drying.** *Iron Age,* Vol. 136, Dec. 5, 1935, pages 34-36. Fenders and other automotive parts are cleaned, prior to application of primer and finishing coats, by washing with chemical cleaner, rinsing and drying. At the plant of Graham Paige Motor Corpn. drying is done in oven as parts travel through. "Burn-off" with gas-fired torches held by workmen is next operation. Japanning ovens are heated by gas-fired heaters. Temperature of 490° F. is maintained in high heat zone of ovens which are designed for 2-coat work. When a 4-coat finish is given, the work goes through twice. The 2 ovens including dip tanks, drain boards and other accessories, form a continuous automatic unit. VSP (8f)

Production of Artificial Patina on Copper (Zur Herstellung künstlicher Patinierungen auf Kupfer). E. T. Richards. *Die Metallbörse,* Vol. 25, Mar. 9, 1935, pages 306-307; Mar. 16, 1935, pages 338-339. Artificial green patina often fails in outdoor exposure by the action of moisture and sun radiation. Additional lacquer films are ineffective since the underlying patina destroys the lacquer coating. The composition of the Cu-rich alloy also exerts a certain influence, As-bearing alloys being particularly suited for producing artificial green patina. A great number of recipes are given and Vernon's recent developments in Great Britain are reviewed. EF (8f)

Black Coloring Methods for Brass Ware (Schwarzfärbung von Messingwaren). R. Liebetanz. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Nov. 1, 1935, pages 458-459. Several recipes are given and detailed instructions are furnished. EF (8f)

Metal Coloring (Metallfärbung). A. Busser. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Apr. 15, 1935, pages 162-163. Recipes for securing 23 different color effects. EF (8f)

Enamelled Automobile Headlamps in U. S. A. *Synthetic & Applied Finishes,* Vol. 6, July 1935, page 102. 7000 sets of head and tail lamps protected by an enamel coating are turned out daily by the Ford Lamp Works at Flat Rock. The lamp coatings are required to withstand 1000 hours in salt spray test. Prior to enameling the steel base is made rust proof in a bath chiefly containing Zn phosphate and a toner or oxidizer which converts any ferrous phosphate formed into an insoluble ferric phosphate. Details of all operations are given. EF (8f)

Cellulose Plastics for Pipe Line Covering. *Synthetic & Applied Finishes,* Vol. 6, Oct. 1935, page 171. Discusses a nitro-cellulose plastic designated as Pyralin and produced by the Du Pont Co. as a spiral wrapping for buried pipe lines. EF (8f)

Enamel Company Laboratory Is Striking Symphony of Light and Color. W. G. Gude. *Steel,* Vol. 97, Dec. 16, 1935, pages 25-26, 79-80. Describes laboratory of Chicago Vitreous Enamel Product Co., Cicero, Ill., with special attention to use of porcelain enamel for interior finish of walls, light fixtures, columns, shower and toilet stalls, furniture, and, in 2 rooms, ceilings. Stainless steel trim is used also. MS (8f)

A Discussion Relating to Thermal Expansion Methods from Theoretical and Practical Standpoints. C. J. Kinzie & C. H. Commons, Jr. *Journal American Ceramic Society,* Vol. 18, Oct. 1935, pages 306-308. Data on expansion of enamel from interferometer and rod measurements do not agree with calculated expansions from published data of the oxides because no consideration is given to total expansion curve of glass. Conclusions: an enamel having expansion curve exceeding that of Fe probably will not have chipping tendency; enamel having coefficient less than that of Fe will probably chip unless the tendency is counteracted sufficiently by other physical properties determined by the composition. Numerical values of coefficient of expansion are of less value than a graphical comparison of the curve with that of the base. A number of curves are given showing % expansion versus temperature for good, intermediate and poor enamels; with accompanying data on the probability of chipping. WB (8f)

The Painting of Metals. An Extended Abstract. *Metals & Alloys,* Vol. 6, Dec. 1935, pages 361-364. Summary of 5 papers read at Apr. 1935 meeting of American Chemical Society. All organic coatings require pigmenting to make them effective in excluding H_2O and O_2. Preparation of surfaces with phosphates and other chemicals, use of primers and their selection are discussed. WLC (8f)

Metal Container Finishing. Henry F. Frank. *Industrial Finishing,* Vol. 11, Apr. 1935, pages 18-20. Reprinted from 1935 edition of "Packaging Catalog." Describes steps and finishes used on metal containers. Gives an example of finishing collapsible tubes. VSP (8f)

Rust-Proofing Buick Parts by Spraying System. *Industrial Finishing,* Vol. 11, Sept. 1935, pages 20-22, 24. Describes the bonderizing process of the Parker Rustproof Co. used by the Buick Motor Co. to treat stamped metal parts prior to lacquering or enameling. Among the advantages claimed are: (1) Greater and more consistent rust proofing efficiency; (2) Ability to work with lower temps.; (3) Higher output for a given floor space; (4) Higher rust proofing per dollar expended; (5) Freedom from carrying over inert materials on part being bonderized; (6) Elimination of special alkaline chemical cleaning before bonderizing; and (7) Better working conditions for operators. Process consists in giving metal a crystalline phosphate coating which retards corrosion. It also is said to provide an excellent adhesive base for application of finishing materials. VSP (8f)

Anodic Oxidation of Aluminum by Superimposing Three Phase A.C. on D.C. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 14, Aug. 1935, pages 651-678. In Japanese. *Scientific Papers & Abstracts Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 27, Aug. 1935, page 45. In English. The process of anodic oxidation of Al in oxalic acid solutions has been expediently carried out by superimposing single phase a.c. on d.c. to prevent pitting of the Al-anode during electrolysis. Various methods of superposition of polyphase a.c. on d.c. experimentally were tried to decide which is the best for obtaining anodic films of good quality and to facilitate the process in its practical operation. Electrolysis by superimposing 3-phase a.c. on d.c. is claimed to be definitely simpler and more favorable than any other method tested. Hard and adherent films are obtained, the anodic current during electrolysis reverses little, even when appreciable negative voltage is impressed on the anode in each cycle; the energy efficiency of film formation is superior to other methods; the a.c. component introduced in the d.c. generator circuit that menaces the commutation of the machine is suppressed and pitting of the anode in the course of electrolysis is completely prevented. Al plates of 3 grades are tested under various conditions of 3-phase electrolysis. WH (8f)

New Trends in Automotive Finishing. E. W. Windsor. *Industrial Finishing,* Vol. 11, June 1935, pages 16-20; July 1935, pages 24, 26, 30, 32. Excerpts from a paper read before the Automotive Service Conference at Purdue University; advocating synthetic finishes because of their greater flexibility, better gloss retention, increased covering capacity, better surface for repainting and quicker drying. VSP (8f)

9. TESTING

Aircraft: Materials and Testing. L. B. TUCKERMAN. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 3-46. Tenth Edgar Marburg Lecture. The major structural problem in aircraft is light-weight construction, that, is thin-walled construction: thin webs, flanges, thin-walled tubes, sheet surfaces, etc. The limit of spreading the material into thin walls is set by local instabilities; wrinkling, twisting, crumpling or other types of collapse, of the thin material. The problem is to secure the best possible balance between plastic yielding depending upon the strength-density ratio and major or local instabilities dependent upon the modulus-density ratio and finally the transitions between them dependent upon an accurate knowledge of its stress-strain curve. In the light of these conclusions the significant properties, density, strength-density ratio, and modulus-density ratio of selected materials are compared. The comparison shows that from these purely structural considerations, with the materials now available, there is little choice between the 3 types of construction now in use: wood, light Al alloys and high-strength alloy steels. The choice between them must be based on other considerations, ease of fabrication, resistance to deterioration by weathering, etc., and finally upon knowledge of the designs which will utilize best the possibilities of the material. Improvements in the quality of structural metals that increase the ease of fabrication, and improvements in the technique of fabrication and joining of metal together by such processes as riveting, crimping, soldering, brazing and welding will make possible improved designs which are now impossible to fabricate. With the best designs so far produced it is possible to make full use of the strength of materials already available only in relatively small parts of the structure. The modulus-density ratio is still the limiting property of the material and this ratio is practically unaltered by any treatment which can be given a material. Consequently no radical improvement in light-weight construction is at present to be expected from still further increasing the strength of the materials. There is, however, much room for improvement in the knowledge of the possibility of designing to utilize more fully the strength of materials now available. Systematic series of tests on typical structural elements of different materials offer present promise of materially improved light-weight construction. The principles, materials, and technique of light-weight construction developed chiefly in connection with aircraft are being increasingly used in other fields of construction, notably in light-weight railroad trains. VVK (9)

■ 9a. Inspection & Defects, including X-Ray Inspection ■

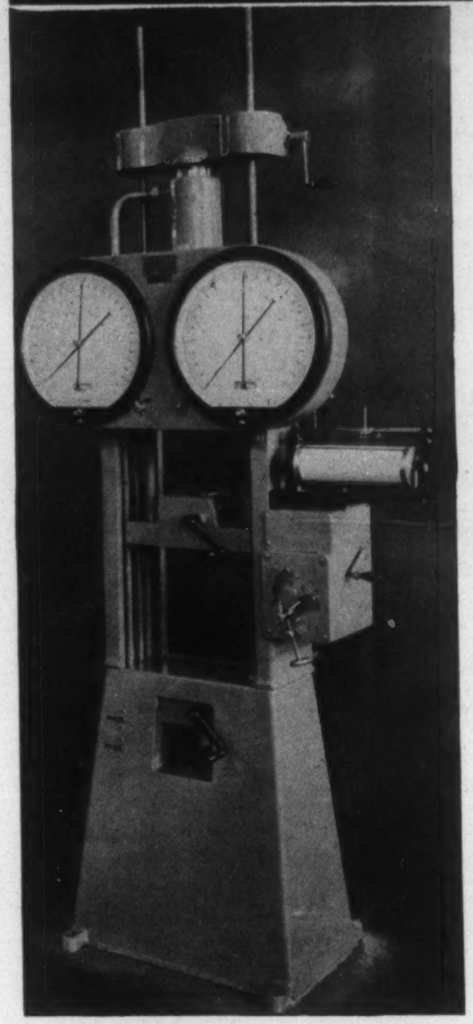
C. S. BARRETT, SECTION EDITOR

Formation of Flakes in Chromium-Nickel-Molybdenum Steels (Quelques remarques sur la formation des flocons dans les aciers au chrome-nickel-molybdène) I. MUSATTI & A. REGGIORI. *Revue de Metállurgie,* Vol. 32, Nov. 1935, pages 531-552. Many heats of 0.30-0.40 C, 0.40-0.60 Mn, 0.30 Si, 0.6-0.8 Cr, 2.7-3.2 Ni and 0.30-0.40% Mo were investigated. These heats had a strong tendency towards flake formation. Non-metallic inclusions are not related in any way to flake formation. Flakes are not caused by segregations caused by liquation of ingots. This was demonstrated by splitting an ingot in two longitudinally along its axis and rolling these halves into billets. Flakes were present in them around the center and were entirely independent of the zone of segregation present at one side. Dendritic segregations do not appear to influence the position of flakes. Hypothesis was checked that the internal tensions resulting from dentritic segregations cause flakes and can be eliminated by interrupting cooling before austenite of segregated zones is transformed into martensite and reheating to about 600° C., so as to decompose austenite. Billets of Cr-Ni-Mo steel were cooled in air from rolling temperature; cooled in air to 280° C., reheated to 600° C. and air cooled; cooled to 280° C., reheated to 600° C., cooled in furnace to 300° C. and air cooled; slowly cooled in furnace to room temperature. Only those cooled slowly to room temperature were free from flakes. Experiments of H. Bennek, H. Schenck & H. Mueller, *Stahl und Eisen,* Vol. 55, page 321, showing the relation between flakes and H were modified by heating steel in H instead of passing through molten metal. Blooms full of flakes were rolled into 80 x 80 mm. squares which were perfectly free from flakes after air cooling from rolling temperature and were used as samples after being machined into 60 x 80 mm. cylinders. They were heated in H_2 at 7 hour intervals for different time and were either air cooled or quenched. At 1150° C. after 28 hour heating all specimens contained flakes. They were located radially around the periphery of the samples at a certain distance from the outside surface and without reaching near the center. Specimens taken from the same bar and heated at 1150° C. in N did not contain any flakes. Giving the same treatment to C, Cr-Ni and Cr-Ni-Mo steels developed small flakes in C steel, larger in Cr-Ni and the worst in Cr-Ni-Mo. Heating in N did not produce flakes, but cooling in it to 700° C. after heating for 5 hours at 1150° C. in H_2 did not eliminate them. Heating in H_2 for 7 hours at 1000° C. produces flakes in Cr-Ni and Cr-Ni-Mo steels but not in C steel. At temperatures lower than 800° C. heating in H_2 does not produce flakes in any of the steels investigated. Flake formation is due to some unknown action of hydrogen. 39 references. JDG (9a)

Inspection of Oil Refinery Equipment. FRANKLIN L. NEWCOMB. *Refiner & Natural Gasoline Manufacturer,* Vol. 14, Mar. 1935, pages 92-97; Apr. 1935, pages 158-162; May 1935, pages 211-218; Aug. 1935, pages 402-408; Sept. 1935, pages 449-454. A series of 5 articles subdivided into 6 divisions: scope of inspection; organization of inspection forces; methods of conducting inspections; records required and their utility; limits for discarding equipment and results of systematic inspection. VVK (9a)

Common Causes of Gear Failures. J. T. HOWAT. *Machinery,* N. Y., Vol. 42, Jan. 1936, pages 302-304. The causes of failure due to improper choice of material and incorrect heat treatment are discussed in a general way. Ha (9a)

Examination of the Surface of Tinplate by an Optical Method. W. E. HOARE & BRUCE CHALMERS. *Sheet Metal Industries,* Vol. 9, Oct. 1935, pages 614-616. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 24L/7. AWM (9a)



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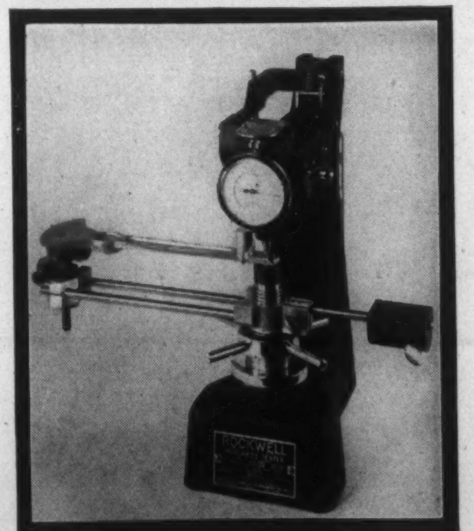

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Sulphur Determination by the Combustion Method in Carbon Steels, High Speed Steels, 18:8, etc. H. A. Kar. *Metals & Alloys*, Vol. 6, Aug. 1935, pages 223-225. 7 references. Describes oxidation as in C determination for the determination of S. The SO_2 is absorbed in Na_2O_2 and subsequently precipitated as $BaSO_4$. WLC (9a)

Non-destructive Testing of Weld Seams (Die zerstörungsfreie Schweissnahtprüfung). R. Berthold. *Archiv für Technisches Messen*, Vol. 5, Oct. 1935, pages T129-T131. Principles and technique of testing with X-rays and γ-(radium) rays are explained. The table shows the required voltages for different thicknesses of steel:

kilovolts	100	150	200	250	300
steel thickness, mm.	15	35	70	85	95
min. size of air inclusion recognizable, mm.	0.2	0.5	0.7	0.9	1.1

The sensitivities with radium for different thicknesses of steel are:

steel thickness, mm.	50	75	100	125	150
air inclusion, mm. recognizable	0.9	1.3	1.5	1.7	2.0

Other test methods without destroying the sample are magnetic methods and sawing (trepanning) off small pieces from the weld seam. Ha (9a)

■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

Untenability of the Conception of an Upper and Lower Yield Point and the Breaking Load of Soft Steel and Other Metals (Über die Unhaltbarkeit des Begriffes der oberen und unteren Streckgrenze sowie der Zerreisslast von weichem Stahl und anderen Metallen) G. Welter. *Metallwirtschaft*, Vol. 14, Dec. 20, 1935, pages 1043-1047. The stress-strain curves of soft steel produced automatically by the conventional types of testing machines are not correct, as they show a drop in load when the test piece starts to stretch at the yield point, and another drop in load after the maximum has been reached and before the test piece breaks. These drops do not actually take place, but are due to the construction of the testing machines. This contention is illustrated by curves obtained by the use of a testing machine loaded with dead weight, lead shot. These curves show a deviation from the straight line at the yield point for annealed .15 C steel, an increase in the rate of elongation, but a slight increase instead of a reduction in the required load. The load approaches a horizontal line at the breaking point, but does not drop. CEM (9b)

The Bend Test and Its Value as a Guide to Ductility. L. W. Schuster. *Proceedings Institution of Mechanical Engineers*, Vol. 129, Jan.-Mar. 1935, pages 251-398; *Engineer*, Vol. 159, Apr. 5, 1935, pages 354-356, 360-361. Includes discussion. The fact is pointed out that scientific study of the bending test is still lacking while tensile and mechanical tests have received scientific attention. The paper correlates ductility shown by tensile and bend specimens, and enables the ultimate performance of a bend specimen to be foretold with reasonable accuracy. Faulty test methods are pointed out and suggestions given for designing the most suitable apparatus to improve results. Curves show the correlation between bending and tensile test ductility, steels of low ductility deviate appreciably. Bending a welded joint to a prescribed angle, or bending such joint through 180° gives no indication whatever of the ductility of the weld metal. For a commercial test on a transverse specimen, measurement of the elongation is essential; the limitations of such a method are described. An appendix treats calculation of stresses theoretically. Ha + VSP (9b)

The "Oxford" Impact Machine. *Engineering*, Vol. 140, July 19, 1935, page 54. Illustrated article giving some particulars of tests recently made for the purpose of improving the technique of impact testing. A summary is given of former tests, the results of which were published by J. H. Lavery and R. V. Southwell as Selected Paper No. 142 of the Institution of Civil Engineers and by H. Hallam and R. V. Southwell in a paper read before Section G of the British Association for the Advancement of Science. These recent tests were made on a series of materials having a wide range of impact figures. They included Al-Si alloy, "Y" alloy, Lautel, "MG7," Duralumin, high-tensile brass, electrolytic Cu, austenitic Ni steel and austenitic Cr-Ni steel "Anka". These experiments show that the Izod test and the Oxford test give very similar rsults. The Oxford test was found to measure more precisely the qualities measured in the Izod test. More experiments are now being carried out in a wider range of materials. The machine is being made by Messrs. Lucy and Company, Eagle Ironworks, Oxford, England. LFM (9b)

Elastic Limit and the Engineer (Elastizitätsgrenze und Konstrukteur). W. Späth. *Zeitschrift für Metallkunde*, Vol. 27, June 1935, pages 132-136. Phenomena which occur when materials are stressed below the endurance limit are analyzed by means of a mechanical model. This is a set of springs, of the material in question, whose displacement due to loading is opposed by a resistance element placed 90° to the direction of load. After effects, damping, and the raising of the endurance limit due to loading are interpreted in terms of the model and related to irregular stress distributions along the "structural imperfections" of Smekal. It is concluded that the mechanical testing of material may be divided into elastic and inelastic regions, these being separated by the endurance limit; and that the elastic limit is of little value to engineers until the effects related to it are better understood. GD (9b)

Testing High Tensile Structural Steels. H. J. Gough & W. J. Clenshaw. *Mechanical World & Engineering Record*, Vol. 48, Oct. 18, 1935, page 378. Special tests were devised at the National Physical Laboratory to test high tensile structural steels owing to a distrust of adequacy of standard testing specifications. WH (9b)

Question of Shape Value (Zur Frage der Formziffer) A. Thum & W. Bautz. *Zeitschrift Verein deutscher Ingenieure*, Vol. 79, Oct. 26, 1935, pages 1303-1306. A relation was sought between the different kinds of stresses so that a characteristic figure could be derived which the designer might safely use. Curves for tensile, bending and torsion stresses are shown together to demonstrate the influence of shape of the specimen. 23 references. Ha (9b)

9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Endurance Limit of Welded Boiler Plate in the Unannealed and Annealed Condition (Die Dauerstandfestigkeit geschweisster kesselbleche im ungeglühten und geglühten Zustand) C. APPALY & F. SAUERWALD. *Metallwirtschaft*, Vol. 14, Oct. 25, 1935, pages 858-861. The welded .09 C boiler plate was tested as welded, after annealing at 930° C. and after stress relieving at 650°. The endurance tests were made at 400° C. The unannealed welded steel had an endurance limit of 10 to 11 kg./mm.² compared with 9 for the parent metal. The endurance limit and microstructure of the parent metal were not affected by the annealing and stress relieving treatments. The 930° treatment reduced the endurance limit of the welded steel to that of the parent metal, and increased the grain size to approximately that of the parent metal. The 650° treatment reduced the endurance limit to a point half way between the welded and parent metal, while the grain size remained unchanged. The higher endurance limit of welded boiler plate is due partly to finer grain size and partly to internal strains. Some of tests were made both by the usual long time method and by the shortened method of Juretzek and Sauerwald. Good agreement by the 2 methods was obtained. 6 references. CEM (9c)

Fatigue Tests and Non-Destructive Tests on Welds. G. A. HANKINS. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 811-816. Part I is a summary of the fatigue experiments on weld metal and weld joints now being carried out at the National Physical Laboratory. Part II is a discussion of inspection of welds. See also *Metals & Alloys*, Vol. 7, Jan. 1936, page MA 25R/5. JLG (9c)

9d. Magnetic Testing

L. REID, SECTION EDITOR

Electric Material Testing in the Manufacture of Motors for Automobiles and Airplanes (Elektrische Werkstoffuntersuchung im Automobil- und Flugmotorenbau). H. SCHNEIDER. *Automobiltechnische Zeitschrift*, Vol. 38, Oct. 25, 1935, pages 512-514. Detection of defects, especially of finest surface cracks by electromagnetic testing of the finished product, axles, crankshafts, and of material used is described. Ha (9d)

Research Work in Magnetics 1933-1934. T. SPOONER. *Electrical Engineering*, Vol. 54, Dec. 1935, pages 1354-1358. A compilation of 211 domestic and foreign publications relating to the theory, research and magnetic properties of magnetic ferrous and non-ferrous alloys is made. Ha (9d)

A New Double Yoke Tester for Magnet Steel (Ein neuer Doppeljoch-Magnetstahlprüfer). F. STÄBLEIN & R. STEINITZ. *Archiv für das Eisenhüttenwesen*, Vol. 8, June 1935, pages 549-554. See *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 502R/7. SE (9d)

Paramagnetism of Metallic Gadolinium above the Curie Point (Le Paramagnétisme du Gadolinium Métallique au-dessus de son Point de Curie). FÉLIX TROMBE. *Comptes Rendus*, Vol. 201, Oct. 14, 1935, pages 652-653. The Curie point for paramagnetism for gadolinium lies at 29.5° C. FHC (9d)

9e. Spectrography

New Spectrum Analytical Investigations (Neue spektralanalytische Untersuchungen). WALTER GERLACH & WERNER GERLACH. *Forschungen & Fortschritte*, Vol. 11, Mar. 1, 1935, pages 86-88. Discusses utilization of spectrum analysis for the determination of metals in organisms, food, paints and of contaminations and their distribution in metals and alloys. EF (9e)

A New Method of Focusing in an X-Ray Spectrograph (Sur une Nouvelle Méthode de Focalisation dans la Spectrographie des Rayons X). V. KUNZL. *Comptes Rendus*, Vol. 201, Oct. 14, 1935, pages 656-658. A description is given of the theory and apparatus for a new focusing device using a crystal with a curved surface for X-ray spectrography. FHC (9e)

Quantitative Spectrographic Analysis of Magnesium Alloys for Manganese and Silicon. J. S. OWENS & T. M. HESS. *Proceedings American Society for Testing Materials*, Vol. 35, Part II, 1935, pages 61-67, discussion pages 68-70. Routine spectrographic analyses of Dowmetal alloys containing approximately 90% Mg have been developed for Mn in the range from 0.009% to 1.5% and for Si in the range from 0.005% to 2.0% to a degree of precision and of accuracy equal to that of routine chemical analysis. The distinct advantages of this method are: (1) rapidity, especially in the analysis of one alloy for several elements and of several alloys for one or more elements, as is normally the case in practice; and (2) the fact that a complete qualitative and semi-quantitative analysis for the metallic constituents of the specimen may be made from the same plate that is used for the quantitative analysis. The spectrographic analysis of an alloy of unknown composition is carried out by the application of the experimentally determined logarithm of the relative intensity of the selected pair of spectral lines, one of Mg and the other of the element under test, to the appropriate analytical curve. 11 references. VVK (9e)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Intermetallic Compounds (Intermetallische Verbindungen). W. KLEMM. *Angewandte Chemie*, Vol. 48, Nov. 16, 1935, page 713. A few general remarks on the chemical side of intermetallic compounds which have, in general, been somewhat neglected in favor of the metallurgical side, serve as introduction to the following articles: **Recent Methods and Results on the Detection of Intermetallic Compounds (Neuere Methoden und Ergebnisse über den Nachweis Intermetallischer Verbindungen).** G. GRUBE. Pages 714-719. The methods now mostly applied to detect intermetallic compounds are X-ray examination, thermal expansion of the alloys and their electric resistance as function of temperature, and determination of the magnetic properties as function of composition and temperature. The methods are discussed and illustrated by examples. The results show that a distinction between solid solutions and intermetallic compounds is often fairly difficult, as the chemical requirements of a compound do not occur in the pure state, as *e.g.*, an ordered distribution of the atoms in the lattice. 12 references. **The Structures of Intermetallic Phases (Die Strukturen intermetallischer Phasen).** G. HÄGG. Pages 720-723. The conception of distinction between solid solution and intermetallic compound has been abandoned as all transition forms between the 2 states occur; the term "phase" is used instead of either of the two. The known phases in metals and metalloids are discussed and arranged in a diagram which shows some gaps to be filled by future research. The analogy with salt compounds is explained and the deviations pointed out. 19 references. **Questions of Energy and Space in the Formation of Intermetallic Compounds (Ueber Energie- und Rammfragen bei der Bildung intermetallischer Verbindungen).** W. BILTZ. Nov. 23, 1935, pages 729-734. The heat of formation of intermetallic compounds is usually lower than of other chemical compounds; *e.g.* it was 16 kcal. for Cu_2Zn_3 and 11 kcal. for NaHg. The contraction in volume has no relation to the energy. The compound of 2 metals consists of metal ions of 2 different kinds which are embedded in the combined, more or less strongly condensed, electron gas of the 2 metals. The electron state is changed in the formation of intermetallic compounds but differently from the formation of salts. 9 references. **Magnetism and Chemical Bonding in Intermetallic Phases (Magnetismus und chemische Bindung in intermetallischen Phasen).** ECKHART VOGT. Pages 734-740. Metallic bonding is due to electrons which have a definite relation to several atoms; these bonding electrons do not belong in pairs to another definite pair of adjacent atoms but form conduction electrons for all the atoms of the metal. It is explained how this electron configuration can be measured by the magnetic state of the metallic compound; examples of Au-Ag and Au-Cu illustrate the determination of the magnetic state. The nature of "crystal magnetism" is explained. 25 references. Ha (10)

Different Structures Deserve Individual Names. HAAKON STYRI. *Metal Progress*, Vol. 28, Aug. 1935, page 40. Deplores the use of "troostite" for a constituent in both quenched steel and quenched and tempered steel. Uses distinguishing adjectives. Believes "troostite" should be used for the dark constituent of quenched steels, sorbite for the tempered martensite not resolved at 1000x, and fine granular pearlite for tempered structure resolved at 1000x. WLC (10)

Criticizing the Term Spheroidized Pearlite. OSCAR E. HARDER. *Metal Progress*, Vol. 28, Aug. 1935, page 40. Objects to the use of pearlite in this connection as the term is bound up with the eutectoid composition and the spheroidized structure is not. WLC (10)

A Simplified Nomenclature. HOWARD SCOTT. *Metal Progress*, Vol. 28, Aug. 1935, pages 39-40. Advocates "fine pearlite" for troostite from quenching and more precise statement of the boundaries between martensite and troostite and between troostite and sorbite. WLC (10)

The Components of Steel, Austenite, Martensite, Pearlite, Sorbite. KENT R. VAN HORN. *Metal Progress*, Vol. 28, Aug. 1935, pages 22-27, 68. Summary of recent findings on the nature of the constituents in hardened C steel without attempt to explain the mechanism of hardening. WLC (10)

Views on the Microstructure of Steel. ALBERT SAUVEUR. *Metal Progress*, Vol. 28, Nov. 1935, pages 65-66. Terms few in number and simple in nature are urged. WLC (10)

Formation of Graphite Eutectic in Iron-carbon Alloys. TOMO-O SATO & SEIJI NISHIGORI. *Tetsu to Hagane*, Vol. 21, Nov. 25, 1935, pages 887-895. In Japanese. 3 kinds of pure white iron (3.54%, 4.05% and 4.85% C) were melted in a high-vacuum furnace which was specially constructed, using W wire as heating element, and thermal analysis was made. The eutectic reaction in pure Fe-C alloys takes place in 2 steps which differ by 7°-10°. This agrees with Ruer and Goerens' result. The change which takes place at the higher temperature in cooling is due to the formation of the austenite-graphite eutectic, and that at the lower temperature, to the austenite-cementite eutectic. 2 kinds of eutectic were observed under the microscope. Therefore, the correctness of the double diagram of the Fe-C system is pointed out. The mechanism of formation of various forms of graphite is discussed. By assuming that degree of dissociation of Fe_3C in molten pig iron decreases as the amount of some impurities (*e.g.*, Cr and S) or dissolved gases (H_2, N_2, CO, and CO_2) increases, the readiness of formation of graphite eutectic in the pig iron melted in a vacuum was explained. Mechanism of formation of mottled iron and reversed chill casting was explained as follows: Solidification of cast iron begins at the surface of the mass; hence, in some conditions, impurities and gases condense in the center of the mass. Therefore, the gray structure forms in the outer part of the mass and the white in the center. TS (10)

The Solid-solution Problem (Das Mischkristallproblem). H. O'DANIEL. *Fortschritte der Mineralogie, Kristallographie & Petrographie*, Vol. 19, Sect. 1, 1935, pages 48-52. Critical discussion of the methods of determining the nature of solid solutions and of the Vegard law. EF (10)

The Orientation of Crystals in Silicon Iron. Richard M. Bozorth. *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 1107-1111. X-ray examination of Si-Fe prepared by N. P. Goss showed crystals so oriented that a [001] direction is parallel to rolling and a (110) plane lies in the rolling plane. Magnetic investigation showed that the crystals magnetize most readily in <001> direction. The high permeability of this Fe is attributed to favorable orientation in the direction of this high permeability. WLC (10)

Method of Identification of Inclusions in Iron and Steel. Wm. Campbell, G. F. Comstock & C. R. Wohrman. *Metal Progress,* Vol. 28, Nov. 1935, opposite page 52. Tabulates etching reagents used and interpretations of their actions on inclusions as means of identification. WLC (10)

Nucleization of Graphite by Manganese Sulphide. H. A. Schwartz. *Metals & Alloys,* Vol. 6, Nov. 1935, pages 328-329. Micrographs show secondary graphite growth about MnS inclusions. WLC (10)

Grain Distortion in Metals During Heat Treatment. C. Nusbaum & N. P. Goss. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 621-632. 7 references. Discussion. Asterism in Laue photographs of heat-treated metals is explained as due to grains being more or less distorted in treatment by obstruction of their free growth. WLC (10)

Simplified Technique for Lattice Parameter Measurements. John T. Norton. *Metals & Alloys,* Vol. 6, Dec. 1935, pages 342-344. Describes simple technique for obtaining X-ray data with the same ease as metallographic data and without greater special skill. WLC (10)

Austenite⟶Martensite⟶Pearlite. The Classical View. Kotaro Honda. *Metal Progress,* Vol. 28, Aug. 1935, pages 34-35. Discussion of mechanism of transformation in C steel and appropriate nomenclature. Advocates the continued use of "troostite." WLC (10)

Alloys of Iron and Manganese. Part XIII. The Constitution of the Binary Alloys of Fe and Mn. F. M. Walters Jr. & Cyril Wells. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 727-750. Includes discussion. See *Metals & Alloys,* Vol. 6, Jan. 1935, page MA 30. WLC (10)

Alloys of Iron and Manganese. Part XIV. Fe-C Alloy Containing 7% Mn. Cyril Wells & F. M. Walters, Jr. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 751-760. 6 references. Presents a section of the ternary diagram Fe-C-Mn at 7% Mn. WLC (10)

Polishing of Cast Iron. Louis Ziffrin. *Metal Progress,* Vol. 28, Dec. 1935, page 52. 4 step technique for polishing cast iron is: (1) grind on alundum wheel (120 mesh) at 1250 r.p.m., (2) grind on paper covered (No. 0 Emery) wheel at 1250 r.p.m., (3) polish on paraffin-covered disc with levigated alumina in liquid soap at 600 r.p.m. and (4) on silk-satin-covered disc with magnesium-oxide paste at 350 r.p.m. Micrographs show results on malleable and gray iron. WLC (10)

Recrystallization of Electrolytic Iron (Ueber die Umkristallisation von Elektrolyteisen). G. Wassermann. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf,* Vol. 17, No. 17, 1935, pages 203-206. Rolled electrolytic Fe crystallizes with a fine grain but heating beyond the A_3 point produces a fairly coarse-grained structure. By quenching from the γ state, a finer recrystallized grain can be obtained. If electrolytic Fe is cooled from the γ state so that the recrystallization temperature wanders gradually along the specimen, long, needle crystals are formed, the shape of which is the more perfect the slower the cooling. Adjoining α-crystals frequently act as nuclei. Armco Fe and low-C ingot Fe behave differently from electrolytic Fe in recrystallization and transformation; the recrystallized structure is always of very fine grain and does not show the needle crystals. The formation of the latter is ascribed to the fact that the number of nuclei of α crystals in the γ-α transformation is at first very small and becomes larger only with increasing undercooling. Ha (10)

Atomic Scattering Factors of Nickel, Copper and Zinc. G. W. Brindley & F. W. Spiers. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Nov. 1935, supplement, pages 865-881. Scattering factors of Ni, Cu, and Zn for Cu $K\alpha$ radiation were measured by the powder method. Intensities are compared with those from KCl. 14 references. Ha (10)

An X-ray Investigation of Lattice Distortion in a Copper-beryllium Alloy. G. W. Brindley & F. W. Spiers. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Nov. 1935, supplement, pages 893-902. The atomic scattering factor was determined for a Cu-Be alloy (solid solution) containing 0.72 Be by weight. A certain distortion over that calculated for the ideal alloy was observed which is ascribed to the filing to which the specimen was subjected and also to the presence of Be atoms. Ha (10)

An X-ray Examination of Lattice Distortion in Copper and Nickel Powders. G. W. Brindley & F. W. Spiers. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Nov. 1935, supplement, pages 882-893. Chemically prepared and filed powders were investigated and the atomic scattering factors found definitely less in Ni than in Cu powders; the extent of the lowering increases with the order of the spectrum. This effect is attributed to lattice distortion by filing; the displacement was determined to be 0.106 A.U. for Cu and 0.083 for Ni. Ha (10)

Rearrangements in Iron between 70° and 700° C. (Zur Frage der Umlagerungen des Eisens zwischen 70° und 700°). G. Naeser. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf,* Vol. 17, No. 15, 1935, pages 185-190. The mean specific-heat curve of pure Fe between 70° and 700° C., shows 6 distinct, reversible irregularities at 112°, 198°, 292°, 388°, 487° and 591°. These irregularities seem to point to a relation between rearrangement of the molecules and the ferromagnetism of the Fe. The distances between the points of irregularity and the heat liberated at these points seem to follow a simple law. More experiments are required for full elucidation. 38 references. Ha (10)

X-ray Study of Aluminum-zinc Alloys at Elevated Temperatures. E. A. Owen & Llewellyn Pickup. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Nov. 1935, pages 761-777. Apparatus was designed to obtain rotation powder photographs of metals and alloys at elevated temperatures in a vacuum. The Al-Zn diagram of Tanabe is in best agreement with the X-ray results except in the $(\beta+\gamma)$ region above 360° C. The transformation temperature and the $(\beta+\gamma)$—(γ) boundary was more exactly determined as 272° C. All the phase boundaries were determined; it was found that the γ-phase parameter in the $(\beta+\gamma)$ region decreases with increasing temperature. This fact may produce the age-hardening found in alloys which contain comparatively little β phase. 17 references. Ha (10).

Preparing Metals for Microscopy. F. F. Lucas. *Bell Laboratories Record,* Vol. 14, Dec. 1935, pages 116-120. Ha (10)

X-ray Studies on the Systems Tin-Antimony and Tin-Arsenic. G. Hägg & A. G. Hybinette. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Nov. 1935, supplement, pages 913-928. Structures and homogeneity ranges of the phases in the systems Sn-Sb and Sn-As have been studied. The phase existing at room temperature around the composition SnSb has a homogeneity range from about 45 to 55 atomic % Sn. The unit cell is rhombohedral. With increasing Sb content, volume and deformation of the unit cell increase. No solubility of As in the Sn phase could be detected; two intermediary phases have been found with very narrow homogeneity ranges at the compositions Sn_3As_2 and SnAs. The former has a rhombohedral unit cell, while SnAs has an NaCl structure with the lattice constant 5.716 A.U. As dissolves about 21 atomic % Sn; the dissolved Sn causes an increase in the rhombohedral edge and a diminution of the rhombohedral angle of the As phase. Ha (10)

Non-metallic Inclusion in Steel. Part II. Sulphides. Stephan F. Urban & John Chipman. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 645-671. 17 references. A series of vacuum-melted high-S steels is described as to preparation and inclusions of sulphides of Fe, Mn, Al, Cr, Ti and Zr. These inclusions were studied microscopically and some conclusions reached on their constitution and desulphurizing power. Oxide-sulphides were studied; they differ considerably in structure from either oxides or sulphides. In absence of alloy, oxide-sulphide of Fe resembles the oxide; in the presence of Mn, it resembles sulphide. Red shortness is diminished by presence of oxide. Inclusions described have been subjected to the action of certain etching reagents and the reactions recorded in a scheme for identification. WLC (10)

Retained Austenite and Its Decomposition Ranges in a Quenched Cobalt High Speed Steel. C. A. Liedholm. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 672-692. 9 references. Reports study of micro-structure of quenched (from 2300°, 1450°, and 1600° F., in oil or water) and tempered high-speed steel by hardness tests, specific volume changes, and certain magnetic reactions. Composition was C 0.73%, Mn 0.42%, Si 0.23%, S 0.015%, P 0.017%, Cr 4.17%, W 19.39%, V 1.43%, Co 5.58%. It is indicated that a considerable amount of austenite is retained in the hardened condition, even when tempered to 900° F., and that more is retained by oil than by water quenching. Retained austenite decomposed rapidly at 1000°F. and above. Changes in martensite began at 400°F. and in austenite probably between 700° and 800°F. After tempering at 1300°F., changes seem to have been completed. WLC (10)

Microstructure of Galvanized Ingot Iron. American Rolling Mill Co. *Metal Progress,* Vol. 28, Sept. 1935, opposite page 48. Five micrographs of galvanized coating at 1000x (erroneously reported as 100x). WLC (10)

Lead Bronzes with Special Consideration of Manganese as an Alloying Element (Eine Studie über Pb-Bronzen unter besonderer Berücksichtigung des Mn als Leg.-Element). J. Wecker & H. Nipper. *Zeitschrift für Metallkunde,* Vol. 27, July 1935, pages 149-154. A survey of bearing bronzes shows that, although Sn is required in high-Pb alloys, its use is objectionable because of the widening of the two-phase-liquid region, the introduction of the δ eutectoid, and the possible formation of stannic acid. A suitable substitute for Sn was sought in an alloy containing 30% Pb. Ni reduced the Pb segregation but gave a soft alloy. Alkalies, alkaline-earths, and P had no beneficial effects, and Co required prolonged high-temperature melting and gave poor physical properties. 50-kg. melts containing 63% Cu, 30% Pb, 2% Ni, and 5% Mn showed no segregation under a variety of casting and cooling conditions and no stannic acid was formed. The frictional and shrinkage properties for this Mn-Ni bronze were about the same as for standard white bronzes, whereas the hardness, temperature coefficient of hardness, and impact hardness were all much better than for standard Sn bearing alloys. GD (10)

Investigation of Transformations in Pure Manganese (Umwandlungsuntersuchungen an reinem Mangan). A. Schulze. *Zeitschrift für Metallkunde,* Vol. 27, Mar. 1935, page 66. Review of work of F. Brunke, *Annalen der Physik,* Vol. 21, 1934, page 139. See "Investigations of Pure α-, β- and γ-Manganese," *Metals & Alloys,* Vol. 6, Feb. 1935, page MA 70L/4. FNR (10)

Crystal Structure and Composition of the Rhombic Cobalt Silicide (Kristallstruktur und Zusammensetzung des rhombischen Kobaltsilicides). Bertil Borén, Sven Ståhl & A. Westgren. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29, Aug. 1935, pages 231-235. The crystal structure of the intermediary phase Co_2Si of the system Co-Si was determined by X-ray analysis. It belongs to space group V_h^{16}. Dimensions of the rhombic cell are: a = 7.095 A.U., b = 4.908 A.U., c = 3.730 A.U. The 8 Co atoms and 4 Si atoms of a unit cell occupy the positions: $uv\frac{1}{4}$; $\bar{u}\bar{v}\frac{3}{4}$; $\bar{u}-\frac{1}{2}, v-\frac{1}{2}, \frac{1}{4}$; $u-\frac{1}{2}, \bar{v}-\frac{1}{2}, \frac{3}{4}$. The values of the parameters are, for Co atoms: $u_1 = 0.103$, $v_1 = 0.090$ and $u_2 = 0.772$, $v_2 = 0.193$; and for Si atoms: $u_3 = 0.440$, $v_3 = 0.070$. The structure resembles closely those of FeB, CoB, and Cr_3C_2. ORS (10)

Theory and Use of the Metallurgical Polarization Microscope. Russell W. Dayton. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 119-155. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page 296L/7. (10)

11. PROPERTIES OF METALS AND ALLOYS

Arrangement of Electrons in Supra-Conducting Metals (Die Elektronenfiguration der supraleitenden Metalle). U. DEHLINGER. *Physikalische Zeitschrift,* Vol. 36, Dec. 1, 1935, pages 892-894. Includes discussion. Paper before the XI. Deutscher Physiker und Mathematiker Tag, Stuttgart, Sept. 22-28, 1935, states the following prerequisites for supra-conductivity with reference to elements belonging to the right half of the periodic system: (1) the lattice must have a high coordination number; (2) the atom radius must not be too small; (3) the outer electron shells must possess more than one atom. The difficulties involved in the interpretation of the supra-conductivity phenomenon in elements belonging to the left half of the periodic system are stressed. The author's new system covering the transition metals is set forth. It is pointed out that supra-conductivity investigations with alloys do not contradict the writer's hypothesis. EF (11)

Silicon (Le Silicium). MAURICE DÉRIBÉRÉ. *Métaux et Machines (Science et Industrie),* Vol. 19, Oct. 1935, pages 342-346. Studies sources of SiO_2 and then gives historical study and properties of Si. Numerous kinds of metallurgical binary systems as Fe-Si, Si-Mn, Si-Al, Si-Cr, etc. as well as ternary systems are reviewed. A section is devoted to Si steel, well known properties of which are mentioned. It is pointed out that Si has a primordial effect as graphitizing element in cast Fe. Addition of Si to Cu alloys, light alloys and stainless steels is also dealt with. FR (11)

Alloys—Old and New. H. C. H. CARPENTER. *Metal Industry,* London, Vol. 46, May 10, 1935, pages 509-512. Presidential address to the Iron & Steel Institute. See also *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 506L/7. HBG (11)

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Precipitation-Hardenable Bronzes of a Copper-Nickel-Tin Base (Ueber aushärtbare Bronzen auf Kupfer-Nickel-Zinn-Basis). E. FETZ. *Korrosion & Metallschutz,* Vol. 11, Oct. 1935, pages 217-229. After a review of the efforts to improve the properties of the binary Cu-Sn alloys by addition of a third element, the ternary system Cu-Ni-Sn is investigated thermally and microscopically in the Cu corner of the diagram, in particular for sand-casting alloys. A new α-phase border area is suggested which includes a larger range of hardenable alloys. It was possible to convert all alloys between the limiting concentrations of 10% Sn and 40% Ni into the state where they can be worked mechanically, by homogeneizing. The course of precipitation hardening during annealing for 100 hrs. at several different temperatures was determined in typical alloys between 40% Ni and 10% Sn, whereby maximum hardening effects were found for about equal parts of Sn and Ni and the maximum values of hardness to be directly proportional to the oversaturation. A very close relation between melting point and precipitation-hardening velocity was determined for α-alloys of sufficient oversaturation. Ni improves the mechanical properties of α-bronze sand-castings, especially elongation and proportional limit. With increasing Ni content, the fairly favorable properties of Cu-Ni alloys are approached. Aside from the maximum increase of mechanical properties by the hardening process, the substitution of half the Sn by Ni offers also economical advantages (from the German standpoint). A number of Cu-Ni-Sn alloys which are used in practice, are compiled in a table; curves showing the course of precipitation hardness are reproduced. 28 references. Ha (11a)

Thermal and Electrical Conductivities of Copper Alloys. C. S. SMITH & E. W. PALMER. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 225-245. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 506L/8. (11a)

Bearing Metals for Severe Service. I. Bearing Requirements in Automobile Engines. V. SKILLMAN. *Product Engineering,* Vol. 6, Oct. 1935, pages 362-363. Developments are reviewed. The solid babbitt bearing has now been abandoned and replaced by bronze-back babbitt-lined types, the babbitt being centrifugally cast. Besides this, Cd alloys with Ni and Ag have proved to be successful. **Copper-Lead Bearings.** D. E. ANDERSON. Pages 363-364. Cu-Pb bearings with about 30% Pb are employed for heavy duty service in passenger cars, bus and truck engines. These bearings stand much higher compressive loads than babbitt. **Cadmium-Silver-Copper Bearing Alloys.** L. C. BLOMSTROM. Pages 364-365. Relatively small additions of Ag greatly improve casting qualities of Cd, making it less susceptible to oxidation and improving fluidity, and further increase hardness. The addition of Cu permitted reducing Ag content without reducing hardness. The m.p. is 598° F. (babbitt 465° F.). The friction coefficient is lower than in both Sn and Cu base alloys. They are used in crankshaft bearings. These alloys are susceptible to corrosion from certain lubricating oils; only high grade mineral oils should be used. **Cadmium-Nickel Bearing Alloys.** A. J. PHILLIPS. Page 365. Ni content is 1.3%, with occasional additions of Cu, Mg, Ag and even Zn; they do not modify the alloy structure but stiffen the metal. In general practice the additions are not necessary. The alloy begins to soften at 604° F. It is used in automobile bearings, and where heavy loads and high temperatures occur together. **Lead-Alkali Bearing Metal.** C. H. HACK. Dec. 1935, pages 456-457. Alloys of a Sn or Pb base with additions of Ca or other alkali metals are described. They remain fairly hard up to 400° F.; they are used under heavy load in railway Diesel engines. **Graphited Bronze Bearings.** H. J. SHAFFER. Pages 457-458. They are used particularly for high speeds and heavy loads where they show less wear than oil-lubricated bearings and lower temperatures. The graphite in the grooves spreads a film over the bronze surfaces and reduces friction 25% or more of that found in regular bronze bearings. The graphite is not affected by steam, water, gasoline or oils. Operating data and performance curves are given for all types. Ha (11a)

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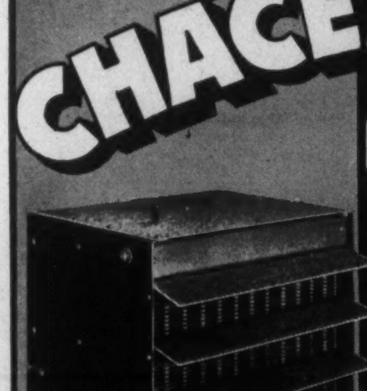

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Development and Commercial Importance of Duralumin (Entwicklung und technische Bedeutung des Duralumins). G. Sachs. *Metallwirtschaft,* Vol. 14, Aug. 30, 1935, pages 691-693. The original composition of duralumin was .5% Mg, 3.5-5.5% Cu, .5-.8% Mn, balance Al, including as impurity about 3% Si. It had a tensile strength of 40 kg./mm.^{2} This alloy has been modified to suit various purposes. To increase the ductility the heavy metal content is decreased, and to raise the strength it is increased. In the heat treated condition 46 kg./mm.^{2} tensile strength can now be obtained and 50 kg./mm.^{2} by the addition of cold rolling. In the highly alloyed grades the quenching temperature range is very narrow and critical and it is essential not to quench higher than 505° C. to obtain good properties. Duralumin does not have very good corrosion resistance, especially in salt air. To overcome this it is clad on both sides with another more resistant alloy, 5 to 7.5% of its thickness, by rolling the two together. In Germany a Cu free Al alloy containing Mg and Si is used, which has higher strength than pure Al. Clad duralumin is available in sheets, but not in tubes or other forms. These can be given an anodic oxidation treatment to increase corrosion resistance. When duralumin in the form of sheets, bars or tubes is heat treated it warps and must be flattened or straightened in a subsequent operation which cold works the metal up to 5%. This increases the yield point and reduces the ductility and, if some time elapses between quenching and cold working, increases the tensile strength. In some cases duralumin is subjected to further cold working after heat treating, aside from straightening. Other modifications of the original duralumin include a Mg free alloy used in wrought and cast form, the English Y alloy, which contains Ni and has good strength at elevated temperatures, and some Cu free alloys, which have better corrosion resistance but lower strength. Al alloys containing 2-9% Mg have good corrosion resistance, but the higher Mg alloys have low strength at elevated temperatures and are subject to galvanic action in contact with heavy metals and to intercrystalline corrosion. CEM (11a)

Standardisation of Aluminum Alloys. *Metal Industry,* London, Vol. 46, June 14, 1935, page 649. Recently standards for certain types of Al alloys were established in Germany. As quoted from *Technische Blätter,* No. 48, 1934, a distinction is made between casting and other alloys. The latter are divided into 8 groups, viz. Dural, Y group, Lautal, Mangal, Anticorrodal, the KS Seewasser, Magnalium and the Silmium group. The outstanding alloys of each group are listed, the approx. chemical analyses given and their characteristic properties mentioned. HBG (11a)

Light Alloy Improved by Cerium. *Machine Design,* Vol. 7, Oct. 1935, page 29. Attention is called to a new British alloy of Cu = 2.5%, Ni = 1.5%, Mg = 0.8%, Fe = 1.2%, Si = 1.2%, Ce = 0.15%, Al = 92.65% in which Ce refines the grain and suppresses the embrittling Fe-Al constituent. The alloy is solution annealed at 515-535°C., water quenched and aged for 16 hours at 175°C. The alloy is primarily intended for high-duty service in the form of die, chill and sand castings. WH (11a)

Fusible Alloy—The Quintenary Eutectic of In, Bi, Pb, Sn and Cd. An Extended Abstract. *Metals & Alloys,* Vol. 6, July 1935, pages 173-174. Gives cooling curves and tabulates with compositions the m.p. for 15 alloys melting between 50° and 88°C. WLC (11a)

Effect of Composition on Mechanical Properties and Corrosion Resistance of Some Aluminum-alloy Die Castings. E. H. Dix, Jr. & J. J. Bowman. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 357-370. Includes discussion. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 334L/4. (11a)

Aluminum-copper-nickel Alloys of High Tensile Strength Subject to Heat-treatment. W. A. Mudge & Paul D. Merica. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 265-278. Includes discussion. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 333L/4. (11a)

Wrought Magnesium Alloys: Mechanical and Rolling Properties. W. E. Prytherch. *Metal Industry,* London, Vol. 46, May 3, 1935, pages 480-482; May 10, 1935, pages 506-508. An extended abstract of a paper presented before the March meeting of the Institute of Metals. See *Metals & Alloys,* Vol. 6, July 1935, page MA 298R/3. HBG (11a)

Transference Number and Valency of Silver in Liquid Silver Amalgams (Die Überführungszahl und Wertigkeit des Silbers im flüssigen Silberamalgam). Karl Schwarz. *Sitzungsberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse, Abt. II b, Chemie,* Vol. 144, No. 7, 1935, pages 350-353. In Ag amalgam, Ag migrates to the cathode. The value (divided by concentration) of the transference number is 4.0 x 10^{-4}. It is highly probable that Ag is in solution as a bi-valent ion corresponding to a diffusion constant of 1.0 x 10^{-5} cm. sec. EF (11a)

Influence of Small Excesses of Mg or Zn on the Hardening of Alloys of Al with $MgZn_2$ (Der Einfluss kleiner Magnesium- oder Zinküberschüsse auf die Aushärtbarkeit von Legierungen des Aluminiums mit $MgZn_2$). R. Schmitt. *Zeitschrift für Metallkunde,* Vol. 27, June 1935, pages 121-125. A series of 17 alloys containing 2.6-14% $MgZn_2$ with excesses of 1.15-6.4% Mg and 1.7-6.8% Zn are annealed at 475° and water quenched, then aged at room temperature, 90°, 125°, 150°, and 175° C. The changes are followed by means of Brinell measurements. After the anneal all samples showed a softening from the as cast condition, followed by a hardening at room temperature which did not reach a maximum after 33 days. The aging data are plotted separately for each alloy. All showed an increase in hardness at all temperatures, which was asymptotic to the time axis below 150°, but at 175° the hardness decreased after reaching a maximum. It is concluded that the process is complicated but dependent upon the $MgZn_2$ primarily, the effect of $MgZn_2$ being greater from 6-9% than from 9-14%. GD (11a)

Plastic Deformation and Age-hardening of Duralumin. P. L. Teed. *Journal Institute of Metals,* Vol. 58, Nov. 1935, pages 495-502 (*Advance Copy* No. 718). Hardness and tensile measurements proved that cold working cold-water quenched duralumin immediately after quenching produced a marked increase in strength and an acceleration of the normal age-hardening process. After subsequent storage at atmospheric temperature there was a small drop in strength below the maximum reached on aging. Cold working fully age-hardened material gave rise to an immediate increase in hardness that was virtually stable. JLG (11a)

Replacing Tin in Lead Cable Sheaths by Small Quantities of Tellurium (Der Ersatz von Zinn in Bleikabelmänteln durch geringe Mengen Tellur). E. KRÖNER. *Elektrische Nachrichten Technik*, Vol. 12, Apr. 12, 1935, pages 113-129. The physical and chemical properties to be met by Pb-cable sheaths are pointed out. Fatigue failure of Pb coverings is most commonly encountered. It has been established that coarse-grained Pb is more subject to this kind of defect. Typical fractures (macro-structures) are shown. Tests on 10 of the most important German brands of refined Pb submitted to a 50% cold deformation and subsequently heated for 12 hours at 160°-180°C. exhibited greatly varying grain sizes due to recrystallization although the chemical analyses do not show very pronounced differences. The effect of small amounts of contamination on the recrystallization of Pb is evident. Only 3 of the German brands investigated exhibited reasonably small grain growth. It is pointed out that a uniformly distributed grain boundary substance inhibits coarse grain. Pb samples containing various additional elements showed an average grain size diameter of 0.1-0.2 mm. after cold rolling. Subsequent annealing at 160°-180° C. changed the grain size due to recrystallization with respect to the different alloy additions as follows: 1% Sn = 0.52, 3% Sn = 0.35, 0.006% Te = 0.12, 0.01% Te = 3.0, 0.05% Se + 0.05% Ni = 0.3, 0.37% Cu = 0.3, 0.03% Co = 4.0, 0.05% Ni = 1.0, 0.02% Se = 1.5, 0.97% Ag + 0.25% Cd = 0.8. The effect of small additions of Te are noteworthy and the physical properties of Te-bearing Pb compares as follows with standard sheath materials:

	cold rolled 75% tensile-strength in kg./mm.²	cold rolled 75% elongation in %	cold rolled 75% + annealed at 160° for 18 hrs. tensile strength	cold rolled 75% + annealed at 160° for 18 hrs. elongat.
softened Pb	2.1	55	2.0	46
+ 1% Sn	1.9	64	2.0	46
+ 3% Sn	2.1	52	2.3	34
+ 0.9% Sb + 0.07% Cu	2.4	44	2.4	44
+ 0.5% Sb + 0.25% Cd	2.9	21	2.4	38
+ 0.05% Te	3.4	16.5	1.95	54

The fractures of tensile test pieces made of the above Pb alloys and the characteristic microstructures of softened Pb and Pb containing 1.82% Sn and 0.05% Te are shown. The Te-Pb has the same strength and higher elongation than the 3% Sn-Pb alloy used heretofore. It possesses a very fine grain and is highly immune to recrystallization and fatigue. The extrusion pressure corresponds to that applied for a 1% Sn-Pb alloy. The melting of Te-Pb is described and the importance of the new cable sheath material is stressed from the economic viewpoint. WH (11a)

Light Weight Cylinders for Compressed Gas. FEDERICO GIOLITTI. *Metal Progress*, Vol. 28, Sept. 1935, pages 62-63. Al alloys are being used in Italy in large quantities for compressed gas at 150 atm. Compositions and properties are:

Name	Cu %	Si %	Mn %	Mg %	Fe %	Ult. Str. lb./in.²
Avional	4.0	0.6	0.6	0.6	0.35	54,-64,000
Lautal	4.0	2.0			0.35	54,-60,000
Anticorodal		1.0	0.6	0.6	0.35	35,-40,000

	El. Limit lb./in.²	Elong. %	Brinell	Sp. Gr.
Avional	35,-40,000	16-20	95-105	2.76
Lautal	28,-38,000	18-25	90-110	2.75
Anticorodal	28,-34,000	18-22	70-75	2.72

Hydraulic test of finished cylinders of Lautal check these properties, 300 atm. results in plastic deformation and corresponds to 27,200 lb./in.² of stress and bursting takes place at 570 atm. or 64,000 lb./in.² WLC (11a)

Research on the Ternary Alloys of Magnesium, Based on the Magnesium-Zinc System. KAZUTAKA NAGURA. *Tetsu-to-Hagane*, Vol. 21, Oct. 25, 1935, pages 812-818. In Japanese. To Mg alloys containing 2, 3 or 5% Zn were added the following elements in amounts of 0.5, 1 and 2%; Ni, Co, Cu, Ag, Ca, Cd, Hg, Al, Tl, Si, Sn, Pb, As, Ti, Zr, Sb, Bi Cr, Te and Mn. These ternary alloys, cast and quenched, were subjected to corrosion tests in 0.1 *N* NaCl solution and artificial sea water. By addition of Ni, Co, Cu, Al, Tl, Pb and Bi, the cast alloys become more corrodible, while with As, Ca, Cd, Hg and Mn they become less corrodible; As and Mn gave the best result for sea water and Ca for 0.1 *N* NaCl solution. The alloys containing Ti, Zr, Sb, Te, Si and Sn showed fairly good results. The corrodibility of these ternary alloys is not improved by heat treatment, except those containing Si, Sn, Tl and Pb. The Rockwell hardness of all these ternary alloys was measured after various heat treatments. The elements which harden the alloys are Cu, Ni, Ag, Al and Bi. The hardening effect of Cd, Hg, As, Sb and Pb which have a low melting point is very small. Hardening due to aging at 150° was tested for all alloys prepared. All the third elements except Ni and Sb increase the hardness of the alloys upon aging, especially Ag, Cd, Hg, Al, Pb, Si and Sn. TS (11a)

Binary Aluminum Alloys II, III. (Über binäre Aluminium-Legierungen, II, III). E. T. RICHARDS. *Die Metallbörse*, Vol. 25, June 8, 1935, pages 721-722; June 15, 1935, pages 753-754; June 22, 1935, pages 785-786; Aug. 17, 1935, pages 1041-1042. The following alloys are discussed in the light of an extensive literature survey with respect to metallurgical and physical properties: Al-Cr, Al-Fe, Al-Ga, Al-Ge, Al-Au, Al-K, Al-Ca, Al-Co, Al-Mn, Al-Mo, Al-Na, Al-Ni, Al-Nb, Al-Pd, Al-P, Al-Pt,Al-Se, Al-Mg, Al-Ta, Al-Te, Al-Ti, Al-Ur, Al-Bi, Al-W, Al-Sn. Some 100 references are given. EF (11a)

Beryllium. ISHIRO ITAKA, YASUZO AOKI & TOMOSADO YAMANOBE. *Bulletin Institute of Physical & Chemical Research, Tokyo*, Vol. 14, Aug. 1935, pages 741-748. In Japanese. *Scientific Papers & Abstracts Institute of Physical & Chemical Research, Tokyo*, Vol. 27, Aug. 1935, pages 48-49. In English. Deals with gravimetric, volumetric and colorimetric determination of Be and estimation of Be in the presence of other metals. WH (11a)

Preparation and Properties of White Gold Alloys (Herstellung und Eigenschaften von Weissgoldlegierungen). *Die Metallbörse*, Vol. 25, July 27, 1935, page 947; Aug. 2, 1935, page 979. Considers the melting, physical properties, pickling, plating, heat treatment, and utilization of alloys of Au-Ni-Zn with approximately 15-20% Ni and 10% Zn. EF (11a)

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11b. Ferrous

V. V. KENDALL. SECTION EDITOR

Approximate Critical Temperature of S.A.E. Steels. M. J. R. MORRIS, R. SERGESON & J. W. GABLE. *Metal Progress*, Vol. 28, Aug. 1935, opposite page 40. Chart shows the Ac_1, Ac_2, Ac_3, Ar_3, Ar_2 and Ar_1 points determined by slow cooling or heating for 95 different S.A.E. steels. WLC (11b)

Alloy Sheet Steel. H. L. MILLER. *Iron & Coal Trades Review*, Vol. 131, Aug. 9, 1935, page 209. See *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 508R/7. Ha (11b)

Steels and Alloys for Permanent Magnets (Aciers et Alliages pour Aimants permanents) A. MICHEL. *Usine*, Vol. 44 Nov. 14, 1935, page 27. Brief review of steels used at present for this purpose and their qualities and treatment. Fe-Co-Mo and Ni-Al steels are at present the most suitable. Ha (11b)

Influence of Aluminum on the Properties of Common Cast Iron (Influence de l'aluminium sur les proprietes des fontes ordinaires) MARCEL PLOYÉ. *Revue de Metallurgie*, Vol. 32, June 1935, pages 248-270; July 1935, pages 302-320; extended abstract, *Foundry Trade Journal*, Vol. 53, Sept. 5, 1935, pages 161, 163. In the first part of the investigation Al additions of 0.02, 0.05, 0.1 and 0.25% were used. Small additions of Al added direct to the Fe from the cupola gave improved fluidity due to the deoxidising effect of the addition. The fluidity was at a maximum with the addition of 0.02% Al. The mechanical test did not show any striking influence from these additions. In the second part of this work the additions of Al were 0.5, 1, 2.5, 5, 7.5, 10, 15 and 20%. With 2-5% Al a progressive change in the condition of the pearlite takes place. From 5-8% a gradual decomposition of the second form of pearlite is noted with the appearance of complex carbide crystals. From 8-10% the structure is described as a mixture of complex carbides with a secondary form of ferrite. From 10-15% a rapid increase in the amount of carbides present takes place at the expense of the ferrite. From 15-20% the amount of carbides decreases and a matrix of ferrite and graphite remains. In the region of 11-14% Al a maximum hardness (Brinell hardness 550) is reached. Fe containing 18% Al is non-magnetic. The author emphasizes the special difficulty in obtaining sound castings with the higher contents of Al. See also *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 508R/5. JDG + AIK (11b)

Production and Use of Alloy Cast Iron (Herstellung und Verwendung von legiertem Gusseisen) E. PIWOWARSKY. *Zeitschrift Verein deutscher Ingenieure*, Vol. 79, Nov. 16, 1935, pages 1393-1396. Recent developments in cast Fe alloyed with Ni, Mo and Cr and applications for certain purposes in America and Germany are shown in tables of composition, chemical and physical properties. Ha (11b)

Temper Brittleness in Cast Iron and the Influence of Nickel and Molybdenum. J. E. Hurst. *Foundry Trade Journal,* Vol. 53, Nov. 14, 1935, pages 372-373. The phenomenon of temper brittleness in steels, particularly Ni-Cr alloy steels is characterized by a pronounced decrease in impact value or toughness in specimens of heat-treated material after tempering at low temperatures, particularly in the region of 500° C. The possibility of the existence of similar phenomena in alloy cast irons does not appear to have been investigated. The experimental results were obtained in the course of an investigation into the influence of alloy additions to Al-Cr and plain Cr alloy cast irons of compositions within the ranges suitable for nitrogen hardening. The chemical composition of the alloy cast Fe (sand cast) was as follows: T.C. = 2.65; G.C. = 1.63; C.C. = 0.99; Si = 2.44; Mn = 0.60; S = 0.075; P = 0.098; Cr = 1.58; Al = 1.37%. The mechanical properties of this Fe were studied both in the "as cast" condition and after 90 hrs. N hardening treatment at 500° C. It was found that the prolonged exposure to the temperature of 500° C. under N hardening conditions is actually accompanied by a slight increase in the ultimate strength results. With a Ni addition to the Al-Cr cast iron there was a reduction in ultimate strength when the iron was subjected to the low-temperature N hardening treatment. The specimens containing (1) Mo and Cr, (2) Mo, Al and Cr and (3) Mo, Ni, Al and Cr, show a negligible falling off in strength after the low temperature treatment. These experiments appear to show that Mo either alone or in conjunction with Al does not bring any reduction in strength under N hardening conditions and that it is effective also in preventing the reduction in strength when Ni is present in the alloy. AIK (11b)

On the Theory of the Dispersion of Magnetic Permeability in Ferro-magnetic Bodies. L. Landau & E. Lifschitz. *Physikalische Zeitschrift der Sowjetunion,* Vol. 8, No. 2, 1935, pages 153-169. In English. The distribution of magnetic moments in a ferro-magnetic crystal is investigated. It is found that such a crystal consists of elementary layers magnetized to saturation. The width of these layers is determined. In an external magnetic field the boundaries between these layers move; the velocity of this propagation is determined. The magnetic permeability in a periodic field parallel and perpendicular to the axis of easiest magnetization is found. EF (11b)

Silicon Steel in Communication Equipment. C. H. Crawford & E. J. Thomas. *Electrical Engineering,* Vol. 54, Dec. 1935, pages 1348-1353. The various steels containing small amounts of Si and their properties are discussed with particular reference to the selection of the most satisfactory alloy for a given purpose. The magnetic properties for Si contents from 0 to 4% are given in curves and tables. 13 references. Ha (11b)

High Manganese Steel. L. Sanderson. *Heat Treating & Forging,* Vol. 21, Dec. 1935, pages 584-586. From *Metallurgia,* Vol. 12, Oct. 1935, pages 171-172, 176. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 78R/6. MS (11b)

Merchant Pig Iron, A Quality Product. Ralph H. Sweetser. *Iron Age,* Vol. 136, Nov. 28, 1935, pages 29, 85. Based on papers read before the Steel division of the American Institute of Mining & Metallurgical Engineers. Discusses the character, "personality" and behavior of merchant pig Fe. One of the contributors stated that the character of grains of C in pig Fe was influenced by the character of coke used in the blast furnace, and that it was possible even to tell from what seam of coal the coke was made. A description of modern methods used for counting spots of C in a mm.^{2} of surface of fracture of pig Fe sample was given. VSP (11b)

The Properties of Gray Iron Castings as Effected (sic) by Superheating Temperatures. M. F. Surls & F. G. Sefing, Michigan Engineering Experiment Station, Bulletin #65, Nov. 1935, 26 pages. Price 25c. Tests on electric superheating of a few lots of gray iron were made, some of these leaving large gaps between the temperatures employed. Other tests heated at one temperature for varying times. Under the conditions of test, considerable C was lost and Si gained. The authors ascribe the changes in properties after superheating or holding chiefly to changes in chemical composition. Furnace operation was not altered to avoid oxidation, no attempt was made to maintain the same C and Si content by additions of C or changing the refractory used to counteract or prevent the changes, nor was a final addition of Si made, as is often done in producing high test iron by superheating. After recounting their experiments, the authors disregard the accumulated evidence of other workers and of practical foundrymen and draw the sweeping conclusion that no advantage is gained by superheating gray iron mixtures above the temperature necessary for pouring. Useful information can be gained from the report if the unjustifiably broad conclusions drawn by the authors are ignored. HWG (11b)

Causes and Effects of Brittleness in Steel. Carl L. Shapiro. *Heat Treating & Forging,* Vol. 21, Oct. 1935, pages 467-472; Nov. 1935, pages 517-521; Dec. 1935, pages 569-574, 576; Vol. 22, Jan. 1936, pages 13-15, 24. Includes bibliography. First 3 instalments cover, in general, same field as first 2 parts of author's article in *Iron Age,* Vol. 135 (see *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 372). These discuss blue brittleness, secondary brittleness, transformation shortness, red-shortness, magnetic brittleness, and carbide brittleness. Deals also with temper brittleness and brittleness in γ iron and in the ranges from sub-zero to room temperatures and from slightly above room temperature to 100°-125° C. MS (11b)

Cast Iron, Report of Committee A-3. Hyman Bornstein, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 74-76. Progress Report. **Report of Subcommittee XI on Methods of Testing.** R. S. MacPherran, Chairman. Pages 77-79. Comparative data are presented on tensile strength determined from tension specimens machined from transverse bars and tension specimens separately cast, from which data it was recommended that the separately cast tension test specimen be eliminated from the specifications. The subcommittee was asked to give a definite recommendation on a method of making transverse test bars. It was found that a number of methods were giving satisfactory results and it was therefore recommended that the manufacturer be permitted to make the bars as he saw fit. The problem is to produce bars free from flaws. **Appendix: Proposed Definitions of Terms Relating to Cast Iron.** Page 80. Definitions are given for information only and as a basis for revision. VVK (11b)

Low Alloy Steels for Oil Refinery Service. R. L. Wilson. *Metal Progress,* Vol. 28, Sept. 1935, pages 29-33. Evaluation of steels for oil refinery service is based upon corrosion resistance, oxidation resistance, lack of brittleness caused by heat or corrosion and high temperature loading characteristics. Increase in resistance to corrosion by crude oils is most marked between 0-2% Cr, above 2% the improvement is slower, from 3-10% resistance increases directly as Cr. Ti moderately improves the corrosion resistance of low Cr steels. Oxidation tests of 1000 hrs. at 1200° F. show 1% W increases oxidation resistance of 4-6% Cr steels by 20% and 0.5% Mo decreases it a like amount. Service records support these results. In 1-2% Cr steels Si and Cr are equally effective in producing oxidation resistance, in 2-5% Cr steel 1.5% Cr is equal to 1% Si. Steel of 2.75% Cr and 2.75% Si has the same oxidation resistance as 5% Cr, 1.25% Si. Ti increases oxidation resistance of 5-6% Cr steels by reason of the tight scale formed. Plain Cr, Cr-Si, and Cr-W steels are susceptible to embrittlement after heating in service. 0.5% Mo is effective in elimination of this feature. In 5% Cr steel Si may cause coarse grain growth and loss of shock resistance and should be accompanied by carbide forming elements to restrict this tendency. Ti in 4-6% Cr and Cr-Mo steel prevents air hardening with other effects mentioned above. Creep tests on 0.15% C steels containing also (1) 0.50% Mo; (2) 0.75% Si, 1.25% Cr, 0.50% Mo; (3) 0.75% Si, 2.50% Cr, 0.50% Mo and (4) 0.40% Si, 5.00% Cr, 0.50% Mo show 1% creep in 100,000 hrs. at 2,700 lb./in.^{2} for plain C steel and 10,700; 15,000; 5,500 and 7,000 lb./in.^{2} respectively for the alloy steels. Two steels developed from this work have following compositions (1) 0.15% C, 0.75% Si, 1.25% Cr, 0.50% Mo and (2) 0.15% C max., 0.75% Si, 2.50% Cr, 0.50% Mo. (1) has exceptionally high creep strength at 1000°-1200° F., 2 to 3 times the corrosion and oxidation resistance of C steel based upon 3 years service, it does not air harden or show temper brittleness and costs half the price of 4-6% Cr steel. (2) has at least half the corrosion and oxidation resistance of 4-6% Cr steel with same creep strength and costs very little more than (1). WLC (11b)

Alloy Steels and Ferro-Alloys in '35. James C. Vignos. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 57-58; *Heat Treating & Forging,* Vol. 22, Jan. 1936, pages 11-12. New structural steels offered during 1935 are (1) Cr steels, containing 0.08-0.4% C, 0.3-1.5% Cr, with Cu, Mn, Mo, and Ni in various combinations and amounts; (2) Mn pearlitic steels, containing 0.08-0.4% C, 0.90-2.50% Mn, with Cr, Ni, Mo, and Si varied to suit requirements; and (3) Cu steels, containing more than 0.5% Cu with C, Cr, Ni, Mo, P, and Si combinations. Grain refinement was outstanding contribution to automotive steels. Higher alloy tool-steels of W and Mo are being replaced by steels with lower content of Mo, Cr, and W. Those steels containing 7-9% Mo, 3-5% Cr, 1-2% W, and 0.80-1.70% V have become well established during 1935. New heat resistant alloys containing considerable additions of Al and Si to the straight high Cr irons and Ni-Cr irons have been commercialized. 4-6% Cr, 0.50% Mo steel has been definitely established for refining corrosive crude oils at high temperatures. Alloys of 2.5% Cr and 0.50% Mo are being used where 4-6% Cr steels are not warranted. Adding Mn and Cu benefits corrosion-resistant steels for certain applications, while introduction of N_2 has improved properties in some cases. Ferro-alloys used for deoxidation and making alloy additions have remained essentially the same, except for special attention given to reduce impurities. MS (11b)

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SOME NOTES ON BETHLEHEM ALLOY STEELS

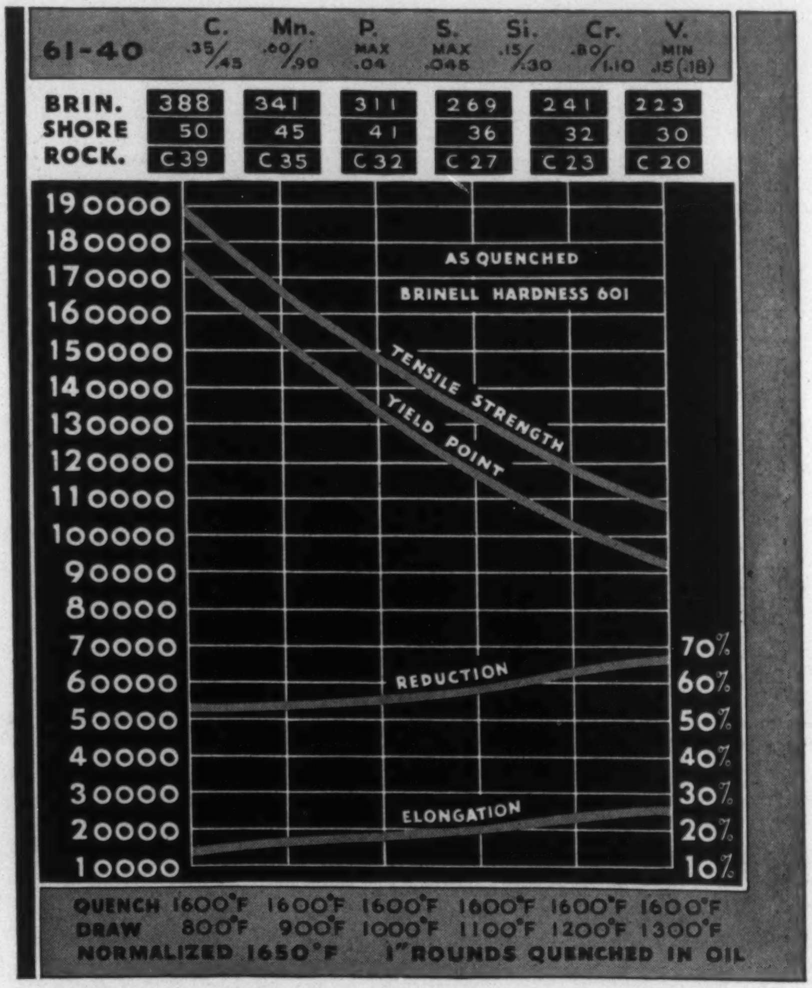
VI - Chrome-Vanadium Steels

The characteristic property that vanadium imparts when alloyed with steel is finer-grained structure. The benefits of vanadium are not entirely reflected by the percentage that the steel contains. Vanadium is a strong deoxidizer and acts in that capacity when added to the molten metal. The effects of vanadium on the physical properties of a heat-treated steel are to promote ductility and accentuate the benefits of other alloying elements, such as manganese and chromium.

The chrome-vanadium steels, which come under the S. A. E. 61xx Series, carry from 0.80 to 1.10 per cent chromium and a minimum of 0.15 per cent vanadium. These steels are made with a carbon content in standard ranges of from 0.10 to 1.05 per cent. In the lower carbon ranges, up to 0.25 per cent, this type of steel is used for carburized parts, such as pneumatic-tool parts, wrenches, roller-bearing cones, pistons, and other uses subject to wear involving high stresses.

In the 0.35 to 0.45 per cent carbon range, chrome-vanadium steels find application as oil-hardened heavy-duty axles, shafts, driving parts, gears, pinions and similar parts. Because of its resistance to rapid deterioration when exposed to hydrogen gas at high temperatures and high pressures, this grade has also found considerable application in the chemical industry.

Chrome-vanadium steels in the 0.45 to 0.55 carbon range have been used in considerable tonnages for flat springs. These steels have also been used for coil springs, mostly in the smaller sizes. In the automotive field a flat leaf of chrome-vanadium steel is applied only for special-purpose or heavy-spring steel (10-95) in the spring assembly.



★ *Physical properties of S. A. E. 61-40, a heavy-duty chrome-vanadium steel.* ★

In the higher carbon ranges, chrome-vanadium steel is applied only for special-purpose or heavy-duty work, as in rams, liners, anti-friction bearings, and machine-tool parts.

BETHLEHEM STEEL

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12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Creep Characteristics of Molybdenum and Chromium-Molybdenum Steels. L. Ya. Liberman & E. N. Bistrov. *Kachestvennaya Stal,* No. 9, 1935, pages 41-46. In Russian. Briefly discusses contemporary methods for creep determination and the marked disagreement between long and short time tests. Tests 52 hours long were made (according to practice recommended by Kaiser Wilhelm Institut für Eisenforschung) on 0.20% C, 0.41 Ni, 0.41 Mo and on 0.22% C, 0.93 Cr, 0.43 Ni, 0.44 Mo steels at 400° and 500° C. The results were in good agreement with the data of other investigators, the parabolic type of creep curve of H. Eckardt (*Dissertation Technische Hochschule Aachen,* 1929) is not supported and Norton's assumptions, (*The Creep of Steel at High Temperatures,* McGraw-Hill, New York) seem to be correct. (12)

Growing Need for Heat Resisting Steel Alloys Adds to Metallurgy Problems. Γ. Holland Nelson. *Oil & Gas Journal,* Vol. 34, Oct. 3, 1935, pages 27-29. Gas polymerization and more intensive oil cracking on the part of refiners promise to tax the ingenuity of metallurgists in perfecting steel alloys that will withstand abnormally high temperatures and pressures. The author summarizes the heat resisting properties of various alloys used in refinery equipment. VVK (12)

Creep Characteristics of Aluminum Alloys. R. R. Kennedy. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 218-232. **Aluminum Alloys at Elevated Temperatures.** *Metal Treatment,* Vol. 1, Autumn 1935, page 132. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 511L/9. JCC (12)

Creep in Relation to Design. D. W. Rudorff. *Metal Treatment,* Vol. 1, Winter 1935, pages 202-204, 209. Abridged translation from *Zeitschrift Verein deutscher Ingenieure.* See "Creep Strength of Metals," *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 374L/2. JCC (12)

Influence of Time on Creep of Steel. A. E. White, C. L. Clark & R. L. Wilson. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 167-192; *Mechanical World & Engineering Record,* Vol. 48, July 19, 1935, pages 53-54. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 511L/2. WH (12)

Some Tests on Tin Bronzes at Elevated Temperatures. J. W. Bolton. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 204-217. Includes discussion. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 511R/2. (12)

Properties of Wrought Aluminum Alloys at Elevated Temperatures. F. M. Howell & D. A. Paul. *Metals & Alloys,* Vol. 6, Oct. 1935, pages 284-288. Reports the effects of prolonged heating on 9 Al alloys of the following compositions:

No.	14S	17S	24S	18S	Y	32S	51S	A51S	53S
Si	0.80%	—	—	—	—	12.50%	1.00%	1.00%	0.70%
Cu	4.40%	4.00%	4.20%	4.00%	4.00%	0.80%	—	—	—
Mg	0.35%	0.50%	1.50%	0.50%	1.50%	1.15%	0.60%	0.60%	1.25%
Mn	0.75%	0.50%	0.50%	Ni2.00%	2.00%	0.80%	—	Cr0.25%	0.25%

Heating was continued until the properties no longer changed with time and properties are reported from tests at the elevated temperatures and at room temperature after air cooling. The room temperature tests tend to approach annealed properties except as the air cooling from certain temperatures tends to heat treat certain alloys. WLC (12)

Stability of Steel Under Stress Up to 1000° F. (as viewed by a turbine designer). Ernest L. Robinson. *Metal Progress,* Vol. 28, Sept. 1935, pages 34-39, 78. Concludes that tests resulting in high strains for short times are inadequate for design purposes. Only tests in which allowable strain is not exceeded during their duration are of value. WLC (12)

Magnetic Properties and Critical Currents of Supra-conducting Alloys. G. N. Rjabinin & L. W. Schubnikow. *Nature,* Vol. 135, Apr. 13, 1935, page 581. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 511R/8. CSB (12)

Effect of Extreme Temperatures on Plain and Alloy Superheater Tube Material (Über den Einfluss zu hoher Temperaturen auf legierten und unlegierten Überhitzerwerkstoff). Wilhelm Rädeker. *Die Wärme,* Vol. 58, Sept. 7, 1935, pages 580-583. Overheated tube material exhibits grooves on the surface. This type of defect is interpreted. The highest wall temperature can be located by means of metallographic investigations. Most of the 24 illustrations included in the paper show microstructures of plain and alloy tube materials. A diagram gives the scaling losses of low alloy and more resistant Si-Cr-Al tube steels up to 700° C. EF (12)

X-Ray Investigation of the Thermal Expansion of Cadmium (Röntgenographische Untersuchung der thermischen Ausdehnung des Kadmiums). G. F. Kosolapov & A. K. Trapesnikoff. *Zeitschrift für Kristallographie,* Vol. 91, Oct. 1935, pages 410-423. The lattice constants a and c of Cd have been determined between 26° C. and 189° C. Within experimental error, the results agree satisfactorily with the earlier determinations of Stenzel & Weerts and Kozima & Rowinsky. The change of the axial ratio c/a was established for the above temperature range. The linear expansion coefficient a_1 perpendicular and $a_{||}$ parallel to the hexagonal axis was calculated. The evaluated thermal coefficient β (volume) agrees with Uffelmann's optical determination. EF (12)

Allotropic Changes in Very Pure Calcium (Allotropische Untersuchungen an sehr reinem Kalzium). A. Schulze. *Physikalische Zeitschrift,* Vol. 36, Sept. 15, 1935, pages 595-598. Ca of 99.9% purity was prepared by repeated sublimation and electrical resistance, thermal expansion and cooling curves were determined. These tests, in addition to X-ray investigations, disclosed that there are 2 allotropic changes in Ca. The α-β transformation takes place at 300° C. and the β-γ change occurs at 450° C. EF (12)

The Embrittlement of Boiler Steel. A Correlated Abstract. Everett P. Partridge & W. C. Schroeder. *Metals & Alloys,* Vol. 6, June 1935, pages 145-149; July 1935, pages 187-191; Sept. 1935, pages 253-258; Nov. 1935, pages 311-316; Dec. 1935, pages 355-359. 158 references. Summarizes the data from experimental work on action of boiler water chemicals, repeated stresses and treatment of steel used in boilers. Summarizes investigations of actual failures in boilers due to these factors or combinations thereof. Prevention of failures lies in maintaining a stable, self-repairing coating on the steel which will separate it from the boiler water. See also *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 339L/1. WLC (12)

Some Tests on Tin Bronzes at Elevated Temperatures. J. W. Bolton. *Metal Industry,* London, Vol. 47, July 19, 1935, pages 63-65. Paper presented at the Detroit meeting of the A.S.T.M. June 24-28, 1935, in a slightly abridged form. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 511R/1. HBG (12)

Effect of Temperature on the Properties of Metals, Report of Joint Research Committee. H. J. French, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 121-125. Progress report. **Appendix: Report on Effect of Long-Time Heating With and Without Stress on Impact Resistance of 18 Per Cent Chromium, 8 Per Cent Nickel Steel (K9 and K19 Steel).** H. C. Cross & F. B. Dahle. Pages 126-132. Cast and wrought 18-8 Cr-Ni steel (K 19) showed moderate loss of impact resistance after heating 100 hr. at 1400° F. and only minor changes in impact resistance with further heating up to 3870 hr. A satisfactory impact resistance remained after 3870 hr. heating at 1400° F. The K 19 steel showed after 1000 hr. heating at 1400° F., a lower percentage reduction than shown by steel K 9 in the 1932 tests but came down to about the same value. Heating at 1400° F. for 100 hr. under stress produced little loss of impact resistance for two 18-8 Cr-Ni steels (K 9 and K 19). The data suggest that embrittlement, measured by impact resistance, may go on at a slower rate in a stressed than in an unstressed specimen. VVK (12)

Tensile Testing Bearing Metals at Elevated Temperatures (Essais de traction à chaud sur alliages antifriction) Jean Galibourg, Leon Guillet, Jr. & Popoff. *Revue de Métallurgie,* Vol. 32, Sept. 1935, pages 393-397. Tests on bearing alloys (compositions not given) indicate that at constant temperature and loads and at constant loads and changing temperatures time-elongation curves show the well known three stages of initial, secondary, and final creep rates. JDG (12)

Tests on the Determination of Creep Limit of Lead Alloys (Versuche zur Bestimmung der Dauerfestigkeit von Bleilegierungen) H. Hanemann & W. Hofman. *Metallwirtschaft,* Vol. 14, Nov. 15, 1935, pages 915-917. The elongation in tension under constant load of pure soft Pb and hard Pb containing 1.11% Sb, was measured over a gage length of 400 mm. Loads from 10 to 55.9 kg./mm.^{2} were used and elongation-time curves were plotted. The creep limit for hard Pb at 20° C. was approximately 22 kg./mm.^{2}, but soft Pb continued to stretch even with the lowest loads used. The time required to produce 1% elongation was also plotted against load and the results compared with those of Moore, Betty and Dollins. The discrepancy between the two may be due to different test methods or difference in materials. Preliminary tests on hard and soft Pb of the same composition but from another source indicated considerably lower results. CEM (12)

Digest of Properties, Carbon and Alloy Steels for Cracking Still Tubes. Babcock and Wilcox Tube Company, Beaver Falls, Pa., 1935 revision, Technical Bulletin No. 6a, Photolith, 35 pages. This gives short-time tensile and long-time creep properties, at elevated temperatures, of 0.10-0.20% C steel, open and killed (the latter has much the better creep properties), of ½ and 1% Mo steels, of 2 and 5% Cr steels with ½% Mo, of 9% Cr, 1½% Mo, of 18 Cr, 8 Ni, and 25 Cr, 20 Ni. The creep data, as determined by Norton at M.I.T. are collected in two figures. Reliable creep data on the plain molybdenum steels in particular, have been scarce. The structures of the different steels are shown, and their corrosion resistance discussed. Steam plant engineers, as well as users of still-tubes, will find these data of interest. HWG (12)

Tentative Specifications for Lap-Welded and Seamless Steel Pipe for High-temperature Service. *American Society for Testing Materials,* A. S. T. M. Designation: A106-34T; *American Standards Association,* A. S. A. No.: B36.3-1935, 11 pages. AHE (12)

Steel Flanged Fittings and Companion Flanges. *American Standards Association,* A. S. A. No.: B16e1-1935, 2 pages. An addendum to the Standard issued in 1932; relates to pressure-temperature ratings and hydrostatic shell test pressures. AHE (12)

Investigation of the Behavior of Metals Under Deformation at High Temperatures. C. H. M. Jenkins & G. A. Mellor. *Iron & Coal Trades Review,* Vol. 131, Oct. 11, 1935, pages 588-589; *Engineering,* Vol. 140, Oct. 4, 1935, pages 370-371; Dec. 20, 1935, pages 673-675; Dec. 27, 1935, pages 699-700. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 33L/6. Ha + LFM (12)

13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

The Scaling of Iron and Steel. *Metallurgist,* Dec. 1935, pages 82-85. A review of 24 references covering the mechanism of scaling, scaling of alloy steels and scaling in complex gases. VVK (13)

Corrosion Below Discontinuous Oxide Coatings, with Special Reference to Magnesium. K. G. Lewis & U. R. Evans. *Engineering,* Vol. 140, Oct. 11, 1935, page 398; *Engineer,* Vol. 160, Oct. 4, 1935, pages 342-343; *Metal Industry,* London, Vol. 47, Sept. 20, 1935, page 300. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 417L/4. LFM + HBG (13)

Rust-Proofing by Cromodine Process. *Iron Age,* Vol. 136, Oct. 31, 1935, pages 34, 76. Steel subjected to bending or denting after being painted is rust-proofed by Cromodine process. It consists of cleaning the steel, surface is wet for 1 min. with cromodine solution, and heated to 180°-190° F. The material may be dipped or solution sprayed on, following which the steel is rinsed in hot H_2O and dried. Gives results of tests. The process was developed by American Chemical Paint Co. VSP (13)

Development of Specifications for Protection of Underground Pipes. K. H. Logan. *Industrial & Engineering Chemistry,* Vol. 27, Nov. 1935, pages 1354-1357. Recent studies of pipe coatings have resulted in increased knowledge of the relative merits of protective coatings and the causes of failure. The more important results of pipe coating research are summarized, and the essential requirements of an adequate protective coating are given. Quantitative data are needed on the properties of pipe coatings and for a series of specifications for coatings suitable for various soil conditions. Such specifications can be developed from available and obtainable data. MEH (13)

A Test for the Water-Resisting Properties of Paints for Steelwork. L. P. McHatton. *Journal Institution of Petroleum Technologists,* Vol. 21, Dec. 1935, pages 989-992. Describes a method of detecting defects, such as pinholes, not visible to the naked eye, in paint films. The method consists of moistening the film to be tested with a solution of KI and starch, the film being covered with muslin saturated with this solution. The KI-starch solution penetrates to the metal through the pinholes, if any, and if the wet muslin is connected to the negative pole of a small battery and the base metal to the positive pole the only path for the current to pass is through pinhole defects in the cooling. Microscopical paint film porosity is evidenced by liberation of I_2 at the negative pole where it combines with the starch to give a blue color. Absence of blue color, obviously, indicates a non-porous paint film. E.m.f. and ohm data on various types of paint films are presented. AAA (13)

Effect of Composition and Heat Treatment Upon Corrosion Resistance of Stainless Steels. Intercrystalline Corrosion. Causes and Prevention. (Influence de la Composition et du Traitement Thermique sur la Résistance à la Corrosion des Aciers Inoxydables. De la Corrosion intercristalline. Les causes et les remèdes) M. Leroux. *Métaux et Machines, Science et Industrie,* Vol. 19, Oct. 1935, pages 331-335. Before the "film" theory due to Evans 2 explanations were given for corrosion: (1) Acid corrosion theory: the presence of at least a small amount of acid was said to be necessary for imparting corrosion. (2) Electrochemical theory: corrosion is due to cell formation resulting from heterogeneity or impurities. A section discusses effect of heat treatment of stainless steels upon their corrosion resistance; (a) quenchable steels: by quenching, carbides go into solution. Tempering up to 500° can be resorted to without impairing corrosion resistance. Steels annealed at 700° are less resistant to corrosion but have a better machinability. (b) austenitic steels: heating at a temperature within the range 400°-900° C. increases corrosion. A section of the article is specially devoted to intercrystalline corrosion which can be prevented as follows: (1) hyperquenching to place all carbides in solution. Pieces are heated to 1150°-1200° C. and rapidly cooled. (2) Decreasing C content of steel. For common 18/8 steel, C must be less than 0.04%. (3) Stabilization by Mn, Ni, W, Mo, Ti, V or Ta additions. Other means for preventing intercrystalline corrosion are also given but are said not to be as yet resorted to in practice: (a) prolonged heating at medium temperature (750°-900° C.). (b) Cold-rolling for sheets. (c) Production of austenitic + ferritic steels which involve carbide precipitation within grains instead of in intergranular portions. FR (13)

Metallizing Water Turbines. *Metallizer,* Vol. 3, Oct. 1935, page 12. Pitted surfaces on the face of the cast Fe rim on the runners of a horizontal 6,800 h.p. turbine were chipped out, blasted with No. 20 steel grit and metal sprayed with phosphor bronze. Inspection after a year of service shows these surfaces to be in practically the same condition as when repaired. Some surfaces were ground smooth, others left in the sprayed condition. No advantage is reported in grinding the surface. Wicket gate rings were also satisfactorily built up with phosphor bronze. Repairs were all made without dismantling the unit. BWG (13)

Black Spots on Tin and Tinned Ware. Sven Brennert. *Iron & Coal Trades Review,* Vol. 131, Aug. 30, 1935, page 317; *Sheet Metal Industries,* Vol. 9, Sept. 1935, pages 545-547. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 512R/2. Ha + AWM (13)

Wrought Iron Plates Protect Span from Brine. *Railway Engineering & Maintenance,* Vol. 31, Sept. 1935, page 516. Discusses "what is probably the latest means adopted to protect the floor of members of steel bridges from the corrosive action of brine drippings," namely the application of wrought Fe protection plates to the top flanges of beams and girders. The corrosion resisting material is solely used as a protective and not as a structural member and protecting sheath. Calls attention to the observed superiority of old wrought Fe bridges in resisting corrosion compared with the behavior of modern steel bridges subjected to similar conditions. WH (13)

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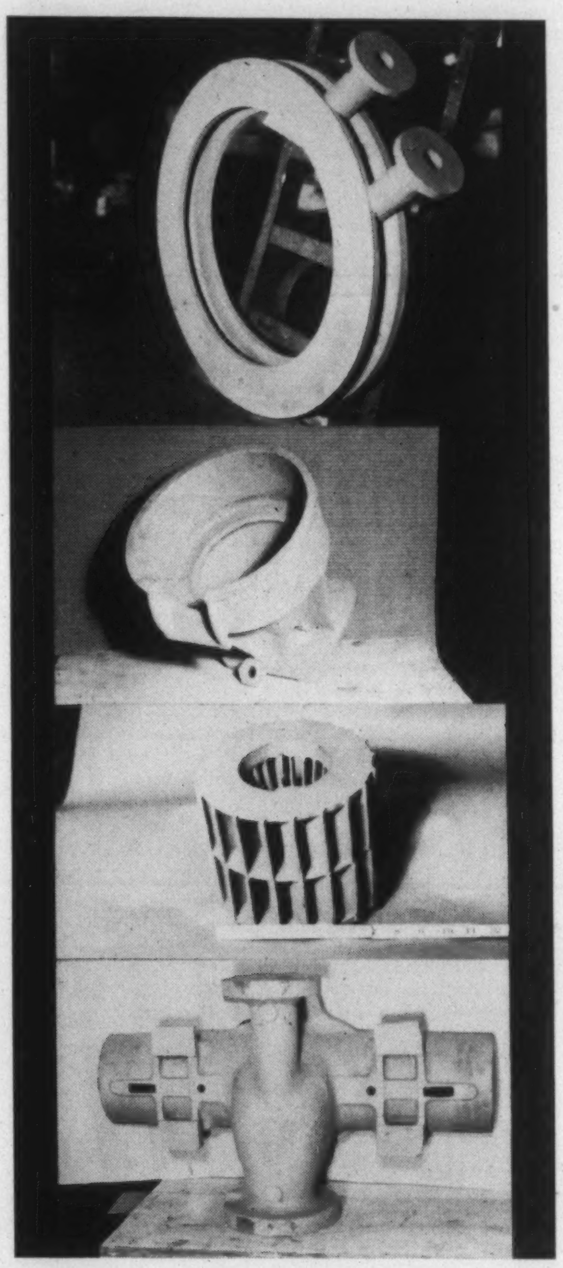

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Direct Oxidation of Platinum and the Nitridation of Some Metals (Copper, Aluminum, Magnesium, Zinc, Iron, Nickel, Tungsten) (Recherches expérimentales sur l'oxydation directe du platine et la nituration de quelques métaux (Cu, Al, Mg, Zn, Fe, Ni, W)). Pierre Grandadam. *Annales de chimie,* Vol. 4, Series 11, July/Aug. 1935, pages 83-146. The first part of this paper (pages 83-105) deals with the direct oxidation of Pt and the properties of its pure oxides. A bluish-gray mixture of Pt, PtO and PtO_2 forms on treating Pt black for 12 hours at 440°-450° C. at an O pressure of 130 kg./cm.^{2} An insoluble residue of pure PtO_2 is left on treating the mixture with aqua regia. PtO_2, which decomposes between 380° and 400° C. represents a good catalyst for the hydrogenation of the double bonds $C = C$ and $C = O$. At least 2 oxides are formed when exposing sponge Pt for 6 hours at an O pressure of 40 kg./cm.^{2} to 450° C., while a black powder of PtO forms at 430° C. and 8.25 kg./cm.^{2} O_2. PtO is also a catalyst for hydrogenation. Part II (pages 106-146) reports on extensive nitriding experiments with the following pure metals: Cu, Al, Mg, Zn, Fe, Ni and W. Metal wires are heated in N_2 and NH_3 and the resistance is measured. The more penetrating physical solution causes a greater resistance increase, whereas a superficial layer forms by chemical reaction. No reaction takes place between gaseous N_2 or NH_3 and Cu or Zn. Al reacts with NH_3 above 100° C.; H_2 reduces the formed nitride at 260° C. An autocatalytic nitridation, beginning at 200° C. was established in the case of Mg and an allotropic modification of Mg is assumed to exist at 280° C. In N_2 no reaction occurs with Fe below 860° C., while reaction begins at 375° C. with NH_3. The reduction of Fe-nitride with H_2 is preceded by solution of H_2. The treatment of porous Fe prepared from reduced nitride with N_2 at 760° C. results in an activation of Fe towards H_2. W reacts with NH_3 at 125°-150° C. and the nitride can be reduced at 200° C. A maximum amount of Ni_3N_2 is formed at 330-530° C. when heating Ni for several hours in contact with NH_3. Above 530° C. the nitride decomposes again. Ni_3N_2 could also be prepared by double decomposition between $NiCO_3$ and Li_3N. The reduction of Ni_3N_2 was accomplished at 250° C., whereby an equilibrium was attained. Porous Ni is also activated by N_2 although to a smaller extent than Fe. Bibliography; Part I, 33 and Part II, 66 references. EF (13)

Brightening Up the Plating Room. R. A. Coolahan. *Monthly Review American Electroplaters' Society,* Vol. 22, Sept. 1935, pages 11-13. Describes Tornesit, a new paint material which is a chlorinated rubber product. Claims for Tornesit are (1) resistance to attack by both acids and alkalis, (2) good adhesion to steel, (3) abrasion resistance, (4) good dielectric strength. GBH (13)

Manganese and Copper Additions to "18 and 8"—Armstrong Metal. Leonard C. Grimshaw. *Metals & Alloys,* Vol. 6, Oct. 1935, pages 264-266. 18-8 containing 4-6% Mn and 2.9% Cu is always austenitic even after severe cold work. This alloy is not susceptible to intergranular corrosion nor is it sensitive to any temperature. It machines much easier than 18-8, best condition for machining results from a 1950° F. air quench, 600° F. draw showing 160-180 Brinell. It is very resistant to H_2SO_4. 1200° F. draw produces best resistance to HNO_3 and subsequent heating in welding operations is not detrimental. Both Cu and Mn are necessary to obtaining this improvement and should be in ratio Mn 2: Cu 1. WLC (13)

A Comparison of the Corrosion Resistance of Several Wrought Irons Made by Different Processes. O. A. Knight & J. R. Benner. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 693-702. Discussion. Tests are reported of the resistance of Roe mechanically puddled, hand-puddled and Byers-Aston wrought irons in 3½% NaCl, 1% H_2SO_4, and 1% HCl. Tests were made in "as received" condition and after removal of the mill scale adhering to the pipe. The order of merit is summarized as follows,

	As received	Descaled
Corrosive	Lowest loss highest	Lowest loss highest
3½% NaCl	Hand; Roe; Byers-Aston	Roe; Hand and Byers-Aston same
1% H_2SO_4	Hand; Roe; Byers-Aston	Roe and Hand Same; Byers-Aston
1% HCl	Roe and Byers-Aston; Hand	Hand and Roe; Byers-Aston.

WLC (13)

Deterioration of Haulage Ropes in Service. S. M. Dixon & M. A. Hogan. *Mechanical Handling,* Vol. 22, Aug. 1935, pages 237-240. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 419R/6. JCC (13)

Subcutaneous Effects During the Scaling of Steel. R. Griffiths. *Sheet Metal Industries,* Vol. 9, Nov. 1935, pages 679-681. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 80R/8. AWM (13)

Corrosion Testing Methods. H. E. Searle & F. L. LaQue. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 249-260. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 36L/8. (13)

Deterioration of Fabrics for Pipe Line Shown in Tests of Many Samples. Gordon N. Scott & Scott Ewing. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 112-113. Considerable data are presented in the form of tables on the loss of strength and deterioration of the fabrics used in the coatings in the field investigation of the American Petroleum Institute and the American Gas Association. The fabrics were exposed to soaking and to soil and the decrease in strength determined. VVK (13)

Resistance of Metals, Especially Rustless Steel, to Corrosion in Cooling Brines (inclusive of electrolytic actions) (Die Korrosionsbeständigkeit metallischer Werkstoffe, insbesondere von nichtrostenden V2A Stahl in Kühlsolen, einschliesslich galvanischer Einwirkungen) P. Schafmeister & W. Tofaute. *Technische Mitteilungen Krupp,* Vol. 3, Nov. 1935, pages 223-226. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 34R/5. Ha (13)

Stainless Alloy Lining Lengthens Life of Oil Cracking Units. O. E. Andrus. *Iron Age,* Vol. 136, Nov. 21, 1935, pages 32-33, 96, 98. Describes the lining of C steel oil cracking units with corrosion-resistant alloys developed by A. O. Smith Corporation. The sheets of alloys are electrically resistance welded at frequent intervals to interior of C steel vessels. 1" spacing of welds is preferred for oil cracking service. Alloys of high Cr and Cr-Ni types are most suitable. VSP (13)

14. APPLICATION OF METALS AND ALLOYS

Nickel and Its Alloys. F. L. LaQue. *Food Industries,* Vol. 7, Dec. 1935, pages 580-582. As used in food processing equipment these metals have the advantages of durability, a fair rate of heat transfer, absence of detrimental effects on the food products and amenability to fabrication. Ni and Monel metal both offer excellent resistance to food acids, brines, alkaline cleaners and chlorine sterilizing solutions of concentrations normally used in food plants. Ni and Monel metal should not be used for milk coolers or other equipment handling milk that is being cooled from above 80° F., but Inconel may be safely used for this purpose. Mustard, boiling vinegar, salt solutions and strong Cl solutions are destructively corrosive. Ni-Resist is especially recommended for cast structural parts of food processing machinery that may be subjected to occasional corrosive conditions from brines or spilled or splashed solutions. BWG (14)

Colorful Possibilities of Porcelain Shown in Finish of New Laboratories. Rogers A. Fiske. *Iron Age,* Vol. 136, Dec. 5, 1935, pages 22-25. Describes and illustrates new laboratory of Chicago Vitreous Enamel Co., Cicero, Ill. Walls are finished in porcelain enamel. Method of construction used introduces a new and practical method for utilizing the unusual finishes and variety of colors offered by porcelain enamel as building material. VSP (14)

Many Castings Are Used on San Francisco Bridge. *Foundry,* Vol. 63, Oct. 1935, pages 22-23, 56, 59. After a brief historical discussion of bridge construction, considers the various structural members used in the bridge and gives the names of firms supplying the material. VSP (14)

Materials of Construction for Food Processing Equipment and Structures. *Food Industries,* Vol. 7, Dec. 1935, pages 599-611. A tabulation is given of many ferrous and non-ferrous alloys and commercially pure metals that should be considered when selecting suitable metals for the fabrication of food plant machinery, accessories, and parts of the plant buildings that are affected by the food processing operations. These tabulated properties include the common or trade name of the material, a manufacturer, composition, physical properties, resistance to corrosion and abrasion, general applications and solubility in food ingredients. To supplement this tabulation brief articles are included in the same issue covering the more important groups of materials. BWG (14)

It's a Good Designer Who Knows His Materials. A. E. Drissner. *Machine Design,* Vol. 7, Sept. 1935, pages 39-41. Utilization of alloy steels and castings, Al, brass, bronze, Cu, etc., in modern machine tools. WH (14)

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14a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Aluminium Die Castings and Their Field of Usefulness in the Telephone Industry. François van Laethem. *Electrical Communication,* Vol. 14, Oct. 1935, pages 121-132. Describes the construction and operation of an Al die casting machine, and illustrates typical castings with the molds used in their production. Parts die cast include selector, brush carriage, and sequence switch frames, line finder switches, subscriber set housings, and dial finger- and back-plates. JCC (14a)

Structures in Aluminum. E. T. Painton. *Mechanical Handling,* Vol. 22, May 1935, pages 143-146. Condensed report of paper read before the Scottish Branch of the Institution of Structural Engineers. JCC (14a)

Lead and Its Uses in the Mineral Industries. Felix Edgar Wormser. *Mining & Metallurgy,* Vol. 16, Dec. 1935, pages 493-497. Deals with the various uses of Pb in mineral industries. Discusses applications in storage batteries, Pb cable sheathing, white, red and blue Pb as pigments, solder, babbitts, Pb in building, etc. Includes table giving composition of storage battery plates. VSP (14a)

Aluminum. J. R. Akers. *Food Industries,* Vol. 7, Dec. 1935, pages 587-588. Al possesses wide adaptability to conditions and requirements of the food industries. After many years of attention by public health and nutrition investigators Al and Al salts have been proven non-toxic and without physiological effect unless administered in amounts from 50 to 100 times the quantity that could possibly be taken into any food by being cooked in Al. It is attacked by alkaline salts and Cl, hence care in cleaning is necessary. Al paint is very suitable for use in food establishments. BWG (14a)

Utilization of Aluminum Instead of Copper Transmission Lines (Verwendung von Aluminium an Stelle von Kupferleitungen). *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 90, July 15, 1935, pages 260-261. Data on the adoption of Al (with and without steel reinforcement) for high voltage lines in U. S. A., Canada, Great Britain and Germany. EF (14a)

Aluminum Gains Favor in the Furniture Field. *Iron Age,* Vol. 136, Nov. 28, 1935, pages 30-33. Describes the Al furniture made by the General Fireproofing Co., Youngstown and cites various installations. VSP (14a)

Lead. F. E. Wormser. *Food Industries,* Vol. 7, Dec. 1935, page 586. Pb is not used extensively in the food industry but is important in building construction and maintenance. BWG (14a)

Cast Rotor Conductors. Aluminum Alloys Used in the Manufacture of Small Squirrel Cage Induction Motors. E. C. Wadlow. *Metal Industry,* London, Vol. 47, Oct. 11, 1935, pages 363-367. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 376R/8. HBG (14a)

Rolling Stock of Light Metal Alloys (Rollmaterial aus Leichtlegierungen gebaut. Matériel roulant construit en alliages légèrs). A. M. Hug. *L'Allégement dans les Transport,* Vol. 4, Mar./Apr. 1935, pages 42-47. In German & French. Author offers evidence to show that Al alloys are also suited for heavy load carrying and otherwise severely stressed members of rolling stock. EF (14a)

Low Weight Aluminium Bodies of Flexible and Subdivided Design (Carrosséries légères en aluminium d'une nouvelle formule de construction souple et sectionnée. Leichte Aluminium-Karosserien neuer biegsamer und unterteilter Konstruktion). Emile Henry. *L'Allégement dans les Transport,* Vol. 4, Jan./Feb. 1935, pages 2-5; Mar./Apr. 1935, pages 37-41. In French and German. Due to the adoption of Al alloys and a special construction, a new low weight body, designated as "Million-Guiet," has been developed which is suitable for rail buses, ordinary buses and trucks. The special structural features are abundantly illustrated. EF (14a)

14b. Ferrous

M. GENSAMER, SECTION EDITOR

Modern Steels and Weight Reduction. J. C. Whetzel. *Blast Furnace & Steel Plant,* Vol. 23, July 1935, pages 464-468; Aug. 1935, pages 533-535; *Heat Treating & Forging,* Vol. 21, July 1935, pages 329-333; Aug. 1935, pages 373-375. Paper read before the American Iron & Steel Institute. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 516R/3. MS (14b)

Production of New Brew Containers Typifies Ingenuity Benefits. L. M. Waite. *Iron Age,* Vol. 136, Nov. 28, 1935, pages 22-28, 82-83. Describes and illustrates the production of beer cans by the National Can Co. and new and remodelled building erected by Brown & Mathews, New York. VSP (14b)

Automotive Industry and Steel Quality. J. R. Miller. *Heat Treating & Forging,* Vol. 21, Nov. 1935, pages 532-534. Calls attention to improvements made in steel quality and manufacturing procedure due to requirements of the automotive industry. All users of steel have benefited thereby. MS (14b)

Seattle Proves Practicality of Open Steel Grid Decking for Bridges. Robert C. Hill. *Steel,* Vol. 97, Nov. 18, 1935, page 33; Dec. 2, 1935, page 40. Bascule bridge was widened to provide 2 additional automobile roadways. As operating mechanism of bridge could not carry an additional load, wood deck, weighing 45 lbs./ft.^{2} was replaced by open steel grid, weighing 22 lbs./ft.^{2} Thirty months use of new type deck shows that it is ideal in all kinds of weather, eliminates automobile accidents, keeps itself clean, and costs little to maintain. MS (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Experiments with Two Thin Metallic Films Pressed Together (Versuche mit zwei aufeinandergepressten dünnen Metallschichten). Alexander Deubner. *Naturwissenschaften,* Vol. 23, Aug. 9, 1935, page 557. More complete details and discussion will appear elsewhere. If one lays 2 films (1 to 2 x 10^{-6} cm. thick) of evaporated Ag (one on glass, the other on celluloid) together, and presses them with a rubber stamp the characters appear darker in contrast to the unpressed background. When the films are separated this effect disappears. This result may be obtained repeatedly. The same blue color exists in the united films as for a single film and indicates that these are true metallic films. The explanation of the effect rests upon the dependence of the wave length of the light absorbed upon the path of the free electrons. Conductivity measurements verify this conclusion. HAS (15)

Static Electricity in Nature and Industry. Paul G. Guest. *United States Bureau of Mines Bulletin* 368, 1933, 98 pages. The literature on static electricity is reviewed. General observations, experiments, industrial hazards, and safeguards are described. Over 260 references are given. The industries concerned include Al, aviation, building, chemical, cleaning and dyeing, cotton, grain, mining and handling coal, paper and printing, petroleum, S, and sugar. AHE (15)

How to Improve Steel Structures. H. L. Whittemore. *American Metal Market,* Vol. 42, Oct. 17, 1935, page 9. The modern developments of alloy steels and light metals with steel-like properties are reviewed and possibilities of improving in mechanical and economical direction discussed. Ha (15)

Plant Improvements Offer Definite Assistance to Profitmaking. T. S. Hammond. *Steel,* Vol. 97, Oct. 21, 1935, pages 46, 48. Discusses modernization in Fe and steel plants. Among opportunities for improvement are power-plants, material handling, furnaces, and dust collecting. MS (15)

Overhead Material Handling Facilities Now Recognized as Production Tools. A. C. Garnett. *Steel,* Vol. 97, Oct. 14, 1935, pages 33-34. Steel producing and metal-working industries are realizing importance of providing sufficient properly engineered crane and allied facilities so as to get full results from production equipment. MS (15)

Why a Brass Company has a Steel Metallurgist. *American Metal Market,* Vol. 42, Oct. 25, 1935, page 5. The necessity arises from the great amount of steel tool and testing methods applied in brass manufacture. Ha (15)

Research in the Steel Industry. John Johnston. *Pennsylvania State College Bulletin* No. 18, 1935, pages 11-23. The making of steels best fitted for the purposes that they are to serve and the contribution that research can make to this end are discussed. The past contributions of research to the steel industry are outlined, especially scientific studies outside the industry. The physical and mechanical properties of any ordinary or low-alloy steel depend on the final architecture of the metal and not on the way in which this detailed structure came about. Undue emphasis has been laid on the ordinary chemical specifications. Behavior is determined not only by the proportions of the elements usually analyzed for, but also by the presence of very small proportions of elements such as O_2, N_2 and possibly H_2. The useful properties of a steel are affected much less by the mineral particles visible under the microscope than by those which can not be seen with present technique. AHE (15)

15a. Economic

Non-Ferrous Metal Mining Industry (Russia). G. Popov. *Tzvetnuie Metallui,* Mar. 1934, pages 32-44. In Russian. Report on status and immediate problems of non-ferrous metal mining industry in Russia. Discusses ore resources, systems used in working the deposits, mechanization, labor problem, reasons for unsatisfactory technical condition of mines, and gives suggestions for further improvements and development of the Russian non-ferrous metal mining industry. BND (15a)

Copper Ore Base of Transcaucasia at the Beginning of the Second 5-year Plan. M. P. Rusakov. *Tzvetnuie Metallui,* Mar. 1934, pages 15-31. In Russian. The Cu resources of Transcaucasia are estimated at 825,000 tons Cu, 0.9 of which is in the form of low Cu ores. These ores contain also 20,000 tons Mo. The deposits are favorably located with respect to transportation, water supply, power, etc. Gives a detailed report of geological exploration conducted in 1932-1933. A discussion is given of advisability of building a new independent smelting plant at Agarak Deposits. BND (15a)

Lead in the Djeskasgan District. K. I. Satpaev. *Tzvetnuie Metallui,* Apr. 1935, pages 23-29. Describes the origin and geology of the Cu-Pb ore deposits of the Djeskasgan District (Russia). The Cu resources are estimated as 3.2 million tons metallic Cu. The present smelters produce 6500 tons Cu annually, and construction of new smelters is planned to bring the annual production up to 150,000 tons Cu. Preliminary exploration revealed Pb in concentrations which warrant further detailed exploration of the deposits in order to determine accurately the quantity of Pb before the final plans of the new Cu smelters are drawn up. BND (15a)

Modernize or Stay Put? Steel Mills Must Recognize Obsolescence. G. W. Burrell. *Steel,* Vol. 97, Sept. 16, 1935, pages 32, 34. Much of the equipment of steel mills is obsolete. When business improves, poorly-equipped plants will be handicapped greatly unless they modernize by revamping old equipment or by replacing it with most modern now available. Gives examples of obsolescence in ore unloaders, coal handling equipment, open-hearth charging machines, and gas-producers. MS (15a)

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The Future of Tin—III Finding Tin. *Tin,* Oct. 1935, pages 1-4. A non-technical discussion of interest to general readers is given of prospecting for Sn. Value of deposits depends not only on the Sn content but cost of treatment. Presence of pyritic impurities necessitates an extra roasting process; presence of Pb, Bi and similar impurities may necessitate chemical treatment. Many companies today are working tailings and dumps of old mines. A Sn famine is not expected but necessity for working mines which are now considered uneconomical may force higher prices later. BWG (15a)

Trends in American Alloy Steel Output. E. F. CONE. *Metals & Alloys,* Vol. 6, Nov. 1935, pages 329-330. Statistical. WLC (15a)

Trends in Stainless Steel Production. E. F. CONE. *Metals & Alloys,* Vol. 6, Dec. 1935, pages 347, 349. Statistical. WLC (15a)

Primary, Secondary, and Scrap Metals. M. V. VON BERNEWITZ. *Blast Furnace & Steel Plant,* Vol. 23, Nov. 1935, pages 772-774. Discusses importance of scrap and secondary metals industries of the United States. Largely statistical. Tabulates annual production of Al, Cu, Fe, Pb, and Zn from ores for 1929-1934; annual production of secondary Al, Sb, Cu, brass, Pb, Ni, Sn, and Zn for 1929-1934; annual exports of Fe and steel scrap to principal importing countries for 1930-1934; and annual exports of Al, Cu,and brass for 1929-May 1935. The United States is now exporting ferrous scrap at a rate of $23,000,000 a year and is producing secondary non-ferrous metals worth $127,000,000 a year or more. MS (15a)

The Non-Ferrous Mining and Metallurgical Industry in Spain. E. JIMENO & F. R. MORRAL. *Metals & Alloys,* Vol. 6, Nov. 1935, pages 317, 321. Statistical and descriptive. WLC (15a)

■ 15b. Historical ■

Faraday, the Metallurgist. R. A. BULL. *Metal Progress,* Vol. 28, Dec. 1935, page 55. A tribute to Michael Faraday. WLC (15b)

The Spanish Mine: Brief History and Recent Metallurgy. B. D. HARDEN. *Mining & Metallurgy,* Vol. 16, Oct. 1935, pages 415-417. Gives a brief history of Spanish mine in Nevada county, California. Includes a flow sheet, daily mill report and a 15 day mill cost sheet. VSP (15b)

A Gold-smith Shop in the Tenth Century (Eine Goldschmiedewerkstatt im 10. Jahrhundert). WILHELM THEOBALD. *Forschungen & Fortschritte,* Vol. 11, Feb. 20, 1935, pages 77-78. The author dug out, translated and interpreted Theophilus' diversarium artium schedula, which contains minute description of the Au working methods and tools in the tenth century. EF (15b)

Discovery of the Double Quench for Carburized Parts. W. P. WOODSIDE. *Metal Progress,* Vol. 28, Dec. 1935, pages 29-31. Describes accidental discovery of the value of double quenching carburized 3.5% Ni steel to produce tough, hard gears (1907). WLC (15b)

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CURRENT NEWS ITEMS

Program for Open-Hearth Conference

The nineteenth annual conference of the Open-Hearth Committee of the American Institute of Mining and Metallurgical Engineers will be held at the Hotel Statler, Detroit, April 16 and 17. The tentative program for the conference is as follows:

April 16

9:30 A.M.—Registration.

10:00 A.M.—Introductory remarks by Chairman, L. F. Reinartz; report financial status of the Committee, J. T. Breunich; remarks by Dr. George B. Waterhouse, director of A. I. M. E. and professor of metallurgy, Mass. Institute of Technology.

10:30 A.M.—Furnace Construction: (a) Introduced by W. Buell; (b) Discussed by H. C. Barnes; (c) Special port design, Emil Vierow; (d) Nose port, E. L. Ramsey; (e) Checker construction, George Danforth; (f) Sloping back wall vs. composition back walls, Ernest Schwartz; (g) Molds and Stools: (1) Copper molds and stools, J. D. Sullivan; (2) Corrugated vs. plain molds; (3) Method of heating molds where frequent mold changes must be made; (4) What effect has the size of mold on rimming qualities of steel?; (h) Steel cinder pots, Wm. Johnston, Jr.

2:00 P.M.—Refractories: Introduced by J. D. Sullivan; discussion by E. F. Cone; (a) Loose insulation vs. preformed brick; (b) Discussion of front and back wall maintenance: (1) Ritex C, Forsterite, Kromag, No. 290 Magnesite. What effect on banks?; (c) Best method to patch holes in furnace bottom; (d) When should old checker brick be thrown away?; (e) Salvage value roof insulation brick; (f) Long sleeve brick.

3:30 P.M.—Operations: (a) Temperature control of open-hearth metal, introduced by Dr. Chipman; (b) Brown temperature control equipment, A. E. Krogh; (c) Furnace combustion control: (1) What pressures being used during various periods of heat? What effects such as decreased oil or other fuel consumption—less impingement of flame on refractories; (2) Is it better to operate under slight vacuum or pressure?; (3) Are CO_2 or O_2 recorders being used for atmosphere control?; (d) Nozzle design, construction, performance, Large nozzles, pour soft steel, effect on quality, influence on internal structure, magnesite nozzles, twin nozzles; (e) tap hole driller; (f) Effect of pouring box on scabs and laminations as well as sheet performance; (g) Use of a carbometer for other than carbon determinations, amount of austenite.

April 17

9:00 A.M.—Quality Problems: (a) Review of work done by British metallurgists on heterogeneity of steel ingots, R. C. Good; (b) Residual metals in open-hearth scrap, J. D. Sullivan; (c) Antimony in scrap, C. R. FonDersmith; (d) Preparation of No. 2 scrap; (e) What effect has copper on 3 in. to 6 in. plate?; What effect has alloy contamination on deep drawing steel?; (f) Variation in quality of pig iron as it affects open-hearth quality, high carbon, medium, low; (g) Sulphur reduction in the open-hearth furnace; (h) Killed steel, how does furnace practice affect physical properties, abnormality, deoxidation, inclusions; (i) Use of aluminum as a deoxidizer when added between blocking a heat and tapping, what effect on grain size, cleanliness?; (j) How can 10,000 to 90,000-lb. killed ingots be poured free from splash and snakes. Is the metal in bottom poured big ingots as clean as in top poured ingots?; (k) Medium high carbon forging steels, what is a good billet yield?, do the yields have any relation to high or low iron oxide control of slag?; (l) Petrographic method for slag control by visual observation of slag cakes; (m) What effect has the temperature drop from first to last ingot on inclusions, segregation, rolling properties?; (n) How can iron oxide be lowered in a slag during the refining period?, how raised?; (o) Sulphur in free cutting steels.

Discussion of open-hearth committee's relationship to the Iron and Steel Division of the A. I. M. & M. E.

2:15 P.M.—Visit to one of Detroit's steel plants.

6:00 P.M.—Informal fellowship dinner, Statler Hotel. Speaker, "Mike" Grady, "The Pennsylvania Railroad Philosopher."

Cost of Radiographing Reduced

The cost of radium on a rental basis has been reduced to $10 for 100 mg. of radium or less for 24 hrs.' use by the Radon Co., 1 East 42nd St., New York. This has been done, says the company, in order that industries interested may take advantage of this agent for radiographing their castings.

A Correction

In the March issue, page 73, some creep data on still tube steels were published with two charts. There was an error in the captions of the charts. Both were designated as showing comparative creep strength for a rate of 1 per cent in 100,000 hrs. The chart at the left should have been 1 per cent in 10,000 hrs.

The editors regret to announce the death on March 9 of Miss I. M. Welch. Although Miss Welch had only recently begun abstracting for Metals & Alloys, she had cheerfully helped in other ways from the time the service was established. Her loss will be keenly felt.

An Exhibition of Die Castings

Impressive in many ways is the exhibition of die casting products, sponsored by the American Die Casting Association, which was opened on March 17 at the Metal Products Exhibits in the International Building, Rockefeller Center, New York. The exhibition is to continue about six weeks. The association is composed of about 26 die casting producers in the United States and some of these have arranged interesting exhibits of many of their products. A statement emphasizing the expansion of this industry in the last 10 years is that, as compared with 22,000 tons of metal consumed for die castings in 1925, there were 77,000 tons used in 1935.

Predominant among the many varied products on exhibition is the wide use of zinc base alloys. On every hand the visitor is confronted with complicated and beautiful castings made of zinc alloys. By no means insignificant also is the display of aluminum base alloy die castings. There is also one small display of a few die castings made of magnesium alloys. Noticeable among the products were certain zinc die castings which had been plated with chromium, nickel, brass, etc., as well as aluminum castings finished with aluminum paint.

The many different industries into which die castings enter and the decidedly complicated products, difficult to cast as perfectly by any other process, combine to emphasize the fact that many of the products, essential to the automobile, to household equipment, to the toy industry and many others, would not be so easy to produce, if indeed obtainable in their present perfectness and form.

Foundrymen and Engineers Hold Joint Meeting in Birmingham

With a registered attendance of 400 foundrymen and engineers from the southern states, and with some representatives from cities of the north, the Fourth Joint Foundry Practice meeting, sponsored by the Birmingham Section of the American Society of Mechanical Engineers, with the A.F.A. cooperating, was by far the most successful of the series. Attendance greatly exceeded the previous mark of 250, and the technical sessions were pronounced the most interesting and valuable held.

This gathering of foundrymen was made the occasion for the formation of a chapter of the A.F.A., which is to be known as the Birmingham District Chapter. L. N. Shannon, vice president, Stockham Pipe Fittings Co., Birmingham, was elected chairman. Other officers and directors elected are: Vice chairman, W. Lee Roueche, McWane Cast Iron Pipe Co., Birmingham; secretary-treasurer, R. R. Deas, American Cast Iron Pipe Co., Birmingham; directors—J. S. Bridges, United States Pipe & Foundry Co., Birmingham; Arthur C. Smith, Hardie-Tyne Foundry Co., Birmingham; William Oberhelman, Hill and Griffith Co., Birmingham; John W. Porter, Alabama By-Products Corp., Birmingham; C. L. Bransford, Republic Steel Corp., Birmingham; Karl Langrebe, Tennessee Coal, Iron & Railroad Co., Birmingham; Charles Hamilton, Alabama Pipe Co., Anniston. The chapter starts off with some 80 members, the largest charter roll of any A.F.A. chapter. The nominations for officers and directors were presented by a committee of which Russell Hunt, Sloss-Sheffield Steel & Iron Co., was chairman. The two-day conference closed with a banquet which some 300 engineers and foundrymen attended.

John Brunner Honored by Swedish Society

The John Ericsson gold medal of the American Society of Swedish Engineers has been awarded to John Brunner, manager of the department of metallurgy of the Illinois Steel Co. of Chicago, in recognition of his development of the new heat "normalizing process" by which steel rails are given greater ductility and resistance to wear and shock.

The presentation was made at the annual dinner of the Swedish Engineering Society at its clubhouse 27 West Fifty-first Street. The society's gold medal is awarded "not more frequently than once every two years, and the recipient must be of Swedish birth or descent."

Tentative List of Exhibitors at Foundry and Allied Industries Exposition

(Continued from page MA171)

Lancaster Iron Works, Inc.	Lancaster, Pa.
Lava Crucible Co. of Pittsburgh	Pittsburgh, Pa.
E. Leitz, Inc.	New York, N. Y.
Linde Air Products Co.	New York, N. Y.
Link-Belt Co.	Chicago, Ill.
J. S. McCormick Co.	Pittsburgh, Pa.
*McIlvaine Foundry Conveyor Co.	Chicago, Ill.
Macklin Co.	Jackson, Mich.
Material Service Corp	Chicago, Ill.
Mathews Conveyer Co.	Elwood City, Pa.
Metal Industry	New York, N. Y.
METALS & ALLOYS	New York, N. Y.
*Metallizing Engineering Co.	Chicago, Ill.
Michigan Smelting & Refining Co.	Detroit, Mich.
Milwaukee Foundry Equipment Co.	Milwaukee, Wis.
Modern Equipment Co.	Port Washington, Wis.
Mt. Jewett Fire Clay Co.	Mt. Jewett, Pa.
Mullite Refractories Co.	Seymour, Conn.
National Engineering Co.	Chicago, Ill.
National Foundry Sand Co.	Detroit, Mich.
Newaygo Engineering Co.	Newaygo, Mich.
New Haven Vibrator Co., Inc.	New Haven, Conn.
New Jersey Silica Sand Co.	Millville, N. J.
Niagara Falls Smelting & Refining Corp.	Buffalo, N. Y.
Wm. H. Nicholls Co., Inc.	Long Island, N. Y.
Norton Co.	Worcester, Mass.
S. Obermayer Co.	Chicago, Ill.
Oiless Core Binder Co.	Cleveland, Ohio
Oliver Machinery Co.	Grand Rapids, Mich.
Osborn Mfg. Co.	Cleveland, Ohio
*Palmer Bee Co.	Detroit, Mich.
Pangborn Corp.	Hagerstown, Md.
Parsons Engineering Corp.	Cleveland, Ohio
Peerless Mineral Products Co.	Conneaut, Ohio
Pen-Rillton Co.	New York, N. Y.
Penton Publishing Co.	Cleveland, Ohio
George F. Pettinos, Inc.	Philadelphia, Pa.
C. E. Phillips & Co.	Detroit, Mich.
Pickands Mather & Co.	Chicago, Ill.
Pittsburgh Crushed Steel Co.	Pittsburgh, Pa.
Pittsburgh Lectromelt Furnace Corp.	Pittsburgh, Pa.
Pyro Clay Products Co.	Oak Hill, Ohio
Pyrometer Instrument Co.	New York, N. Y.
Quandt Chemical Co.	San Francisco, Calif.
Quigley Co.	New York, N. Y.
Ramtite Co.	Chicago, Ill.
N. Ransohoff, Inc.	Cincinnati, Ohio
Ready-Power Co.	Detroit, Mich.
*Reeder Mfg. Co.	St. Louis, Mo.
Republic Coal & Coke Co.	Chicago, Ill.
Republic Steel Corp.	Cleveland, Ohio
Robbins & Myers, Inc.	Springfield, Ohio
Robeson Process Co.	New York, N. Y.
Robinson Machine Co.	Muskegon, Mich.
Royer Foundry & Machine Co.	Kingston, Pa.
Ruemelin Mfg. Co.	Milwaukee, Wis.
Safety Equipment Service Co.	Cleveland, Ohio
Safety First Shoe Co.	Holliston, Mass.
Sand Products Corp.	Detroit, Mich.
Claude B. Schneible Co.	Chicago, Ill.
Schramm, Inc.	West Chester, Pa.
Scully Steel Products Co.	Pittsburgh, Pa.
Shepard-Niles Crane & Hoist Co.	Montour Falls, N. Y.
Simplicity Engineering Co.	Durand, Mich.
W. W. Sly Mfg. Co.	Cleveland, Ohio
Smith Facing & Supply Co.	Cleveland, Ohio
Smith Oil & Refining Co.	Rockford, Ill.
Werner G. Smith Co.	Cleveland, Ohio
Spencer Turbine Co.	Hartford, Conn.
S. P. O. Incorporated	Cleveland, Ohio
Standard Conveyor Co.	North St. Paul, Minn.
Standard Safety Equipment Co.	Chicago, Ill.
Standard Sand & Machine Co.	Chicago, Ill.
Steel Shot & Grit Co.	Amesbury, Mass.
Steelblast Abrasives Co.	Cleveland, Ohio
Sterling Grinding Wheel Co.	Tiffin, Ohio
Steriing Wheelbarrow Co.	Milwaukee, Wis.
Frederic B. Stevens, Inc.	Detroit, Mich.
N. A. Strand & Co.	Chicago, Ill.
Superior Charcoal Iron Co.	Grand Rapids, Mich.
Swan Finch Oil Corp.	Chicago, Ill.
Tabor Mfg. Co.	Philadelphia, Pa.
Taggart & Co.	Philadelphia, Pa.
Tamms Silica Co.	Chicago, Ill.
Tennessee Coal, Iron & R. R. Co.	Birmingham, Ala.
Warner R. Thompson Co.	Detroit, Mich.
Titanium Alloy Mfg. Co.	Niagara Falls, N. Y.
Treat-Nantke Co., Inc.	No. Tonawanda, N. Y.
Truscon Steel Co.	Cleveland, Ohio
W. S. Tyler Co.	Cleveland, Ohio
Union Carbide Co.	New York, N. Y.
United Compound Co.	Buffalo, N. Y.
United States Electrical Tool Co.	Cincinnati, Ohio
United States Graphite Co.	Saginaw, Mich.
United States Steel Corp.	Pittsburgh, Pa.
Vanadium Corp. of America	New York, N. Y.
Van Dorn Electric Tool Co.	Cleveland, Ohio
Vesuvius Crucible Co.	Swissvale, Pa.
A. T. Wagner Co.	Detroit, Mich.
Whitehead Brothers Co.	New York, N. Y.
Whiting Corp.	Harvey, Ill.
E. J. Woodison Co.	Detroit, Mich.
Yale & Towne Mfg. Co.	Philadelphia, Pa.
Young Bros.	Detroit, Mich.
Zanesville Sand Co.	Zanesville, Ohio
Combined Supply & Equipment Co.	Buffalo, N. Y.
Detroit Testing Laboratory	Detroit, Mich.
Dings Magnetic Separator Co.	Milwaukee, Wis.
Hutton H. Haley & Associates	Detroit, Mich.
Hanna Furnace Corp., Ecorse	Detroit, Mich.
International Correspondence Schools	Scranton, Pa.
Safety Magazine Pub. Corp.	New York, N. Y.
Scully-Jones Co.	Chicago, Ill.
United States Hoffman Machinery Corp.	New York, N. Y.

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* Not definite.

Promotions of Nickel Co. Officers

Robert C. Stanley, president of The International Nickel Co. of Canada, Ltd., has announced that four members of the executive staff had been elected to new positions.

Dr. John F. Thompson, for the last five years the sole vice-president of the company, has been made executive vice-president, and Dr. Paul D. Merica, formerly assistant to the president, Donald MacAskill, general manager in charge of Canadian operations, and D. Owen Evans, delegate director of The Mond Nickel Company, Limited, have been elected vice-presidents.

The Baltimore Division and Baltimore Tube Co., division of **Revere Copper & Brass, Inc.**, have been consolidated and hereafter will operate as the Baltimore Division. Sales offices are at 1301 Wicomico St., Baltimore, Md., which is the address of the former Baltimore Tube Co. Branch offices of this division are located in Philadelphia, Atlanta, and New Orleans. R. S. Stringer is vice-president of Revere's Baltimore Division and R. S. Hodges, sales manager.

Ernest C. Kron, a graduate of the University of Minnesota in 1930, has joined the staff of **Battelle Memorial Institute**, Columbus, Ohio. Mr. Kron, who has been a steel mill metallurgist since graduation, has been assigned to the division of process metallurgy at Battelle.

A. M. Steever has been appointed superintendent of the **Columbia Tool Steel Co.'s** manufacturing plant at Chicago Heights, Ill. Mr. Steever began his business career in the shops of the Buick Motor Co. of Flint, Mich., from which position he joined the first metallurgical division established by the Chevrolet Motor Co., in Flint. During the last two years, Mr. Steever has been associated with the Lindberg Steel Treating Co. and the Lindberg Engineering Co., and still retains his directorship in the latter. He is a member of A.S.M., A.I.M.E., A.S.T.M. and S.A.E. He has been very active in supporting the work of the A.S.M., having served on the Chicago Executive Committee for many years and as chapter chairman 1928-1929.

The **Cooley Electric Furnace Co.**, 1411 East Twentieth St., Indianapolis, announces the appointment of **R. R. Cooley** to the position of production manager. Mr. Cooley received his education at Purdue University, and for many years was employed in the study and application of refractories. He is the brother of W. B. Cooley, President of the company.

A "Directory of Materials used in Design of Machines" has been published by *Machine Design*, Penton Publishing Co., Cleveland, as part of its March issue. Its 30 pages or so contain a brief description of iron, steel and non-ferrous alloys and plastics and other non-metallic materials by trade names. The entire presentation is instructive and valuable.

MANUFACTURERS' LITERATURE

Angle Plate-Holocator

The manufacturer claims that the precision drilling and laying out of dies and drill jigs can now be performed to very accurate requirements with this toolmakers' device. Illustrated. Dayton Rogers Mfg. Co., Minneapolis, Minn. (387)

Arc Welding

A book "Automatic Arc Welding by the Electronic Tornado" gives a full explanation of this system of automatic carbon arc welding. Lincoln Electric Co., Cleveland, O. (388)

MoTung High Speed Steel

An illustrated booklet devoted to the above, contains information under these divisions: working and treatment, surface protection, high heat temperatures, drawing temperatures, effect of treatment, etc. An index is included. Universal Steel Co., Bridgeville, Pa. and Cyclops Steel Co., Titusville, Pa. (389)

Improved Fabrication of 18-8 Chromium Steels

Outstanding properties of these steels are reviewed in an illustrated booklet, to point out the need for improved fabrication. The presence of columbium or titanium in the steel and of columbium in the rod has been found to eliminate susceptibility to intergranular corrosion in the base metal zones adjacent to the weld. Linde Air Products Co., New York, N. Y. (390)

Heroult Electric Furnaces

According to the manufacturer the Heroult electric furnaces embody the most modern electrical equipment, are suited to the widest range of uses, and are extremely rugged, dependable and efficient in operation. American Bridge Co., Pittsburgh, Pa. (391)

Refractory Cement

Bulletin No. 317, describes Q-Chrome neutral-base refractory cement which was designed for severe-service duty. Quigley Company, Inc., New York, N. Y. (392)

Phosphor Bronze

A leaflet lists the sizes in which this company's twelve-inch stock bushing bars are now offered. The Phosphor-Bronze Smelting Co., Philadelphia, Pa. (393)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (394)

Special Atmospheres in the Heat Treatment and Razing of Metals

A reprint of the above article by C. L. West Research Engineer, is offered by The Electric Furnace Co., Salem, O. (395)

Centrifugal Castings

Bulletin C-2 is devoted to these castings which are available in the same analyses as the stationary-cast range of heat and corrosion resistant alloys which they supplement. Michigan Steel Casting Co., Detroit, Mich. (396)

Dolomite Refractories

This interesting pamphlet presents the case of Clinkered vs. Calcined Dolomite in the basic open-hearth steel furnace. Basic Dolomite, Inc., Cleveland, O. (397)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections Available Forms and Shop Practice has been published by The Dow Chemical Co., Midland, Mich. (398)

Ladle Fluxes

The advantages of using fluxes for aluminum, brass, bronze, copper, nickel, iron and special alloys are listed in a leaflet of The Maluminum Co., Indianapolis, Ind. (399)

Hi-Steel

Information concerning chemical composition, physical properties and corrosion resistance of this steel is offered by the Inland Steel Company, Chicago, Ill. (400)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (401)

Seamless Flexible Tubing

Bulletin 1936-1 contains the statement that American tubing is the most reliable type of flexible metal conveyor obtainable for services where absolute, 100 per cent tightness is essential. American Brass Company, Waterbury, Conn. (402)

Optical Pyrometer

The Burrell optical pyrometer, a direct reading instrument originally designed for use with the Barrett fusion furnace and equally useful for other work requiring an optical pyrometer with a temperature range from 1500 to 3000 deg. F., is described and illustrated in a leaflet published by the Burrell Technical Supply Co., Pittsburgh, Pa. (403)

Nickelsworth

The Jan.-Feb., 1936, issue of this publication contains some interesting items on the use of nickel. Well illustrated. International Nickel Co., Inc., New York, N. Y. (404)

Rust-Proofing

Bulletin No. 7-7 covers all phases of the Cromodine process for rust-proofing steel products. Illustrations of the results of both accelerated and actual service tests prove the value of Cromodizing. American Chemical Paint Co., Ambler, Pa. (405)

Bearing Security

This leaflet lists the four essentials of a bearing metal and claims that Ajax Bull Bearing alloy embodies them. Ajax Metal Co., Philadelphia, Pa. (406)

Flame-Otrol

This automatic gas shut off which is simple, positive in operation and operates with split second speed, according to the manufacturer, is the subject of an illustrated pamphlet. The method of operation is described. Diagrams. Thermo Control Devices, Inc., Chicago, Ill. (407)

Speed Recorders

An illustrated folder describes these recorders which show the operator current conditions, draws for management dependable records of performance, and if desired automatically operates signals. Leeds & Northrup, Philadelphia, Pa. (408)

Brazing Alloy

Bulletin No. 5 advocates the use of "Sil-Fos" for joining brass, bronze, nickel, nickel silver, extruding brass and bronze, Monel metal and other non-ferrous metals and alloy fusing above 1300 deg. F. Handy & Harman, New York, N. Y. (409)

Industrial Furnaces

This catalog describes, illustrates and gives specifications for furnaces suitable for various applications. Mahr Manufacturing Co., Minneapolis, Minn. (410)

B & L Steel Shafting

This attractive leaflet states that you are assured of close adherence to size tolerances, concentricity and straightness, the maintenance of uniformity and freedom from imperfections in B. & L. Shafting. Bliss & Laughlin, Inc., Harvey, Ill. (411)

Electric Ammonia Dissociators

May be used to replace hydrogen in practically all industrial applications, effecting a decided reduction in gas cost. Ajax Electric Co., Inc., Philadelphia, Pa. (412)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (413)

Radium for Industrial Radiography

This article, written by R. A. Gezelius and C. W. Briggs, containing interesting and important information on the subject, is published in handy booklet form. Radon Company, Inc., New York, N. Y. (414)

Sicromo Steel

High temperature data sheets containing full information on this steel have been issued by The Timken Steel & Tube Co., Canton, O. (415)

Char Carburizing Compound

The manufacturer claims that because of its low dusting loss, low shrinkage and continuously uniform activity, this compound results in marked economies in the carburizing of steel. Char Products Co., Indianapolis, Inc. (416)

Sand Testing Equipment

Catalog No. 103 is a handy reference book on sand testing and foundry control equipment and also contains sand data. It is looseleaf and additional sheets are sent upon request. Harry W. Dietert Co., Detroit, Mich. (417)

Atmospheric Burners

Bulletin 133-3 is concerned with the Sincro Venturi Atmospheric Burners and Immersion Burners. Illustrated. Philadelphia Drying Machinery Co., Philadelphia, Pa. (418)

MANUFACTURERS' LITERATURE

Bimetal

A simplified version of its manufacture and the way it works is contained in this pamphlet. W. M. Chace Co., Detroit, Mich. (419)

Lindberg Control

Bulletin 41 is devoted to this control, whose function it is to balance the rate of heating of a furnace or oven with the varying heat requirements. Lindberg Engineering Co., Chicago, Ill. (420)

Cor-Ten and Man-Ten

Pamphlet describing high-tensile steels developed to meet the need of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (421)

Electric Stress Relieving Heaters

Circular No. 349 contains a description of the above and illustrates the new cylindrical type for local stress relieving of welded seams in high pressure piping, etc.

Published by the same firm: Bulletin No. 300 on "Electrically Heated Coating and Saturation Tanks" and Bulletin No. 310 on "Asphalt Pipe Coating Tanks Heated by Tubular Electric Immersion Units." H. O. Swoboda, Inc., Pittsburgh, Pa. (422)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (423)

Fluxuations

No. 4 contains brief items on the Diesel engines, aiding one's competitors and new methods for improving castings. Foundry Services, Inc., New York, N. Y. (424)

Electric Welding Products

Catalog No. 101 contains information on welding rods (recommended uses for the different types, physical properties, welding procedure, etc.); miscellaneous apparatus, and Wilson arc welding machines. Air Reduction Sales Co., New York, N. Y. (425)

3300 Deg. Super Refractory

An illustrated catalog devoted to "Shamva" Mullite contains information regarding its background, characteristics and uses. Mullite Refractories Co., Shelton, Conn. (426)

Heat Exchanger

Bulletin No. 173 describes the Duriron heat exchanger which is available in the company's corrosion-resisting alloys—Duriron, Durichlor, Durimet, Durco alloy steels and Alcumite. Illustrated. Duriron Co., Dayton, O. (427)

Konik

Data on this steel's physical properties, corrosion resistance and working, are offered by the Continental Steel Corp., Kokomo, Ind. (428)

Value of Draft Control

Bulletin No. L-125 is devoted to the above subject and points out the proper value of the furnace draft and this company's control which consists of a draft switch, a damper motor and a manual station. Illustrated. Shallcross Controls, Inc., Milwaukee, Wis. (429)

Permite Six Foot Cast Bronze Bars

An attractive booklet states that these bars assure a product identical in physical and wear resisting qualities with the finest individual castings. Joseph T. Ryerson and Son, Inc., Chicago, Ill. (430)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-ray has now come to the fore as a tool of the testing laboratory. Kelly-Koett Mfg. Co., Inc., Covington, Ky. (431)

Coreless Induction Furnace

A colorful leaflet contains an explanation of the principle of operation and advantages to be obtained from the use of the Ajax-Northrup electric furnaces. Ajax Electrothermic Corp., Trenton, N. J. (432)

Fire Clay Products

The various Goose Lake products and Therm-O-Flake, for high temperature insulation are briefly described in a leaflet from the Illinois Clay Products Co., Joliet, Ill. (433)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. It is claimed that this series represents the best straight cutting oils obtainable, at a price which meets and beats competition. E. F. Houghton & Co., Philadelphia, Pa. (434)

Republic Double-Strength Steel

A booklet entitled "Agathon Alloy Steels" includes information on the analysis, physical properties and uses of the Double Strength Steels. Illustrated. Republic Steel Corp., Cleveland, O. (435)

Flex-Arc Rays

Data bulletins containing information on arc welding are published by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. (436)

Baking Practice for Oil-Sand Cores

This article by Professor H. L. Campbell is offered in a bulletin by the American Gas Association, New York, N. Y. (437)

Current-Input Controller

Bulletin No. 136 is devoted to this controller for use with furnaces, ovens, platens and other electrically heated units. It is based on proved design but is more flexible in adjustment and more accurate in setting than the original controller. Automatic Temperature Control Co., Philadelphia, Pa. (438)

Liquitol

Bulletin A1-16-A deals with the use of Liquitol for iron and steel castings and ingots. Alpha-Lux Co., Inc., New York, N. Y. (439)

Heat Treatment

The Volcrit method of heat treatment, utilizing a dilatometer rather than a pyrometer for automatic control is described in an illustrated catalog. A complete description of the instrument, its operation, and results are included. Stanley P. Rockwell Co., Hartford, Conn. (440)

Sonittep Products

This booklet discusses heat loss and its control. The advantages of Sonittep insulating cement and its uses are listed. Instructions for its application are included. Graphs. George F. Pettinos, Inc., Philadelphia, Pa. (441)

Torsion Impact Testing Machine

Bulletin No. 114 discusses the Carpenter machine whose operation is very simple and requires only one operator, Baldwin-Southwark Corp., Philadelphia, Pa. (442)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (443)

Research Puts the Diatom to Work

This booklet discusses the history of the diatom from which Celite is made. The four main industrial services of Celite: high temperature insulation, a filter aid, mineral filler and workability agent in concrete are described. Illustrations. Johns-Manville, New York, N. Y. (444)

Air Operated Controllers

Catalog 8900 describes the models and outstanding features of Air-o-Line, a controller with 1-150 per cent throttling range and automatic reset, and other air operated control systems which this company has developed. Brown Instrument Co., Philadelphia, Pa. (445)

Electric Furnaces

A pamphlet describes the "Certain Curtain" furnace which was developed for heat treating at temperatures between 1850 and 2500 deg. F. C. I. Hayes, Inc., Providence, R. I. (446)

Modern Metal Treatment

A colorful pamphlet lists the R & H chemicals available for heat-treating, electroplating and for cleaning metals. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (447)

Combination Impact Tester

This machine will make either izod, charpy, or tension tests quickly and accurately, and with minimum operator effort according to an illustrated pamphlet which is issued by the Riehle Testing Machine Div. of American Machine and Metals, Inc., East Moline, Ill. (448)

Cleaning Barrel

A colorful leaflet contains a list of advantages claimed by the manufacturer of the Rotoblast barrel, some of which are: that it cleans without compressed air; reduces power cost; has no hose line to maintain; cleans fast and gives a clean operation with no escaping dust. Pangborn Corp., Hagerstown, Md. (449)

Pyrometers

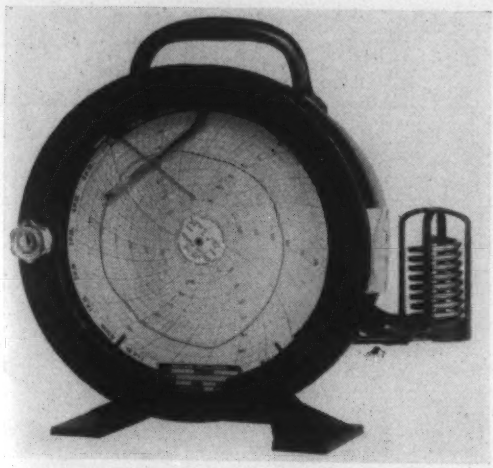
An attractive bulletin describes and illustrates TAG Indicating Potentiometer Controller and Recorder-Controller which incorporate the photo-cell providing, according to the manufacturer, high sensitivity and accuracy of control. C. J. Tagliabue Mfg. Co., Brooklyn, N. Y. (450)

NEW EQUIPMENT AND MATERIALS

New Design Portable Thermometer

The illustration shows the improvement that has been made in this type of recording thermometer; the sensitive element (bulb) has been located where it will respond quickly and accurately to changes in the surrounding temperature.

Mounted out in the clear, the mercury-filled bulb is subjected to the natural air currents and, therefore, records true temperatures. The new design also results in greater sensitivity since the measuring system is in no way affected by the temperature of the instrument case. This is important since many portable thermometers have the bulb mounted in such a way that the bulb is subjected to the temperature of the instrument case. Due to the large mass of metal, it is easy to see why such construction makes such an instrument extremely sluggish.



In addition to these improvements, which result in greater accuracy and sensitivity, the Brown "Self-Contained Portable Thermometer" is built by the Brown Instrument Co., Philadelphia, to withstand the rough handling that must be expected under conditions where portable instruments are used. The metal handle and metal legs are practical and sturdy. The black-enameled, die-cast aluminum case is light in weight and corrosion resistant—an ideal combination for a portable instrument. The completely gasketed door is moisture-proof and the door-in-handle lock is tamper-proof.

Brown portable thermometers are used extensively wherever correct atmospheric temperatures are essential for comfort or manufacturing to promote efficiency and improved products. The permanent, easily read temperature record which is produced on a large 8 in., 24 hr. chart, eliminates all guess work.

A Plastic Insulation

A growing demand is reported by Botfield Refractories Co., Philadelphia, Pa., for "Ada-Stic Plastic Insulating Cement," a product added in the past few months. Ada-Stic is claimed to be the most efficient insulation up to 2000 deg. F., has guaranteed coverage, costs less per job, less to install and less to maintain, is reclaimable, requires no other material to secure a fine finished surface, can be applied by hand, trowel, or Botfield's cement spraying equipment. It will adhere firmly to any clean surface, is very tough and will stand up under hard usage, and can be said to have no shrinkage.

Remote Valve Control

To supplement automatic control systems, The Foxboro Co., Foxboro, Mass., developed recently the new "Remote Valve Control." In many processes, automatic controllers stabilize the operation to such an extent that many non-critical flows may be governed by hand valves, which need be readjusted very infrequently. However, if these hand valves are not easily accessible, it is only natural that even the few necessary adjustments will be neglected. Where these conditions exist, a Foxboro Remote Valve Control, mounted on a centrally-located panel, enables the operator to adjust manually the degree of opening of an out-of-the-way, inaccessible valve without moving from his station. With it, he can reset a valve several hundred feet away to control temperature, pressure, flow or liquid level, using readings from his recording instruments to guide him in making the correct adjustments.

A feature of this Remote Valve Control is the extreme precision of valve setting. It is easy to make a change in pressure on the diaphragm motor of the controlled valve as small as ¼ in. of water or less. This means that the valve opening can be altered by as little as a few thousandths of an inch to produce the exact desired flow of controlled medium. Used in conjunction with a Stabilflo valve, the controlled flow can be changed by less than 1 per cent. Due to its original unique design, there is no pumping or vibrating; air pressure on the diaphragm is held exactly at the desired setting.

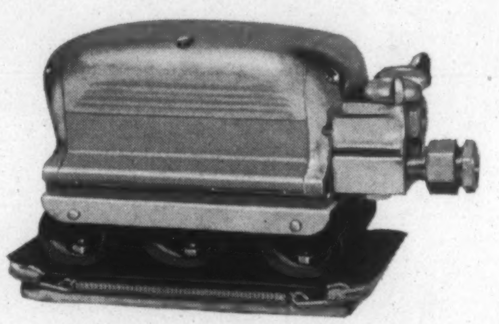
FOXBORO
AIR
0
5
10
15
20
25
30
DIAPHRAGM MOTOR
REMOTE VALVE CONTROL
THE FOXBORO COMPANY
FOXBORO, MASS., U.S.A.

Simplicity and ruggedness mark both the design and construction of the Foxboro Remote Valve Control. Finished in lacquered cast bronze trimmed with buff nickel, it is a fitting addition to any instrument panel.

Improved Sterling Speed-Block Sander

Through constant field and laboratory research, the Sterling Products Co., Detroit, has made major improvements which have greatly increased the usefulness of their "Speed-Bloc Sander." This applies to both wet and dry sanding. Being designed primarily to replace hand sanding and rubbing, its application through these new developments has been increased. It is now applicable to more curved and all flat surfaces, be it on metal, fabric, wood, composition or marble.

The principle of "floating" has been applied to the block and pad. The result is an entirely new motion in that there is no restriction in the movement of the pad proper. Using highly flexible tubular rollers of special rubber composition between the pad and air motor to replace the former bridge construction, the contact of the abrasive surface has been increased to approximately 90%. A proportionate increase in effective abrasive area also applies to curved surfaces. The sanding block is now made of 5 parts instead of one. Parts subject to greatest wear are readily and cheaply replaced. A hardened steel shoe, which receives the thrust, is now vulcanized integrally with the rubber bloc instead of being held by screws.



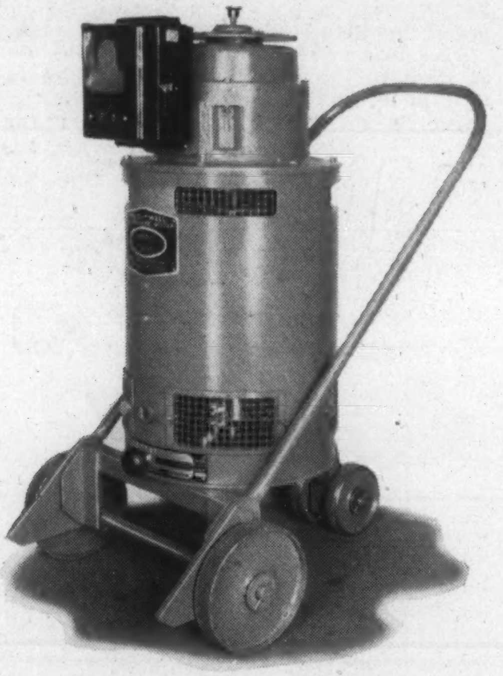
Improvements in the air motor have not only made it a smoother operating unit, but air consumption has also been decreased. Full operation is now accomplished with 50 to 60 lbs., instead of 70 lbs., and delivery of power at top of torque has been measurably increased, yet air consumption is still within original limits of slightly over 6 cu. ft. per min. New pistons are given "anodic" treatment, and leather piston cups are now ingeniously mounted to permit renewal without removing piston. Cross head and driving shaft are made out of one piece "alloy" steel. Double shielded ball bearings are used throughout. The motor exhaust is equipped with a silencer which further reduces vibration and keeps dust out. These changes assure perfect alignment and greatest obtainable durability. The oscillating stroke of the pad is ⅝ in. and the speed remains at 3,000 strokes per min. There is no chasing or graining.

The weight of the complete sander is 7½ lbs. Overall dimensions; 7 in. long, 4¾ in. high, and 3¾ in. wide. A standard sheet of abrasive paper cut in three equal parts fits the pad. The entire machine is now better balanced and responds much quicker to hand guidance. Reports from users in over 40 industries indicate that the Sterling Speed-Bloc Sander is saving from $200 to $700 of every $1,000 which was formerly expended on work now being done with it.

New 75-Amp. Welder Has Stable Arc

The outstanding feature of the new 75-amp. vertical welder announced by the Harnischfeger Corp. of Milwaukee is the extremely stable high speed arc, accomplished through combining the magnetic bridge as a part of the main pole assembly and spreading pole shoes wider around the holes in which the stabilizer coils are embedded. Actual service tests and oscillograph recordings show that this change in generator design has resulted in a still greater degree of current uniformity.

Mounted atop the generator of this newest P&H-Hansen model, is a heavy duty, 5 hp. squirrel cage motor of drip-proof construction. This fan-cooled motor is operated by push buttons and equipped with no-voltage release and overload protection. Connections are available for 110 to 550 volts or for special voltages of 2 and 3 phase, 60 and 50 cycles. Single control is provided for current settings over the entire welding range to reduce dependence on the human element.



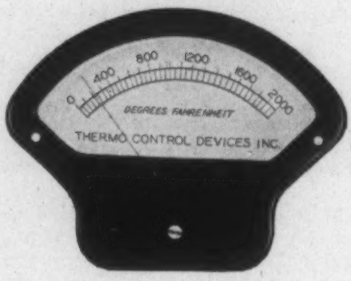
The unit is capable of handling work as light as 24 gage, answering the new demands for welding among manufacturers of metal furniture, furnaces, kitchen utensils, steel sash, containers, etc., since it produces uniformly strong welds even with stainless steel and non-ferrous alloys. It is 15½ in. in diameter, 41 in. high and weighs 600 lbs. It is furnished with stationary or wheel truck mountings or with lifting bail.

"Kote-Rax" for Coating Plating Racks

The Lea Mfg. Co., Waterbury, Conn., producers of "Lea Compound," "Learok" and "Lea Nickel Glo," announces an added service to the plating industry. Extensive facilities have been installed for coating plating racks with "Kote-Rax," a tough, translucent, rubber-like compound with high corrosion resisting properties and dielectric strength. Being immune to attack from the solutions commonly used in plating chromium, cadmium, silver, nickel, etc., Kote-Rax is claimed to greatly reduce maintenance on the equipment and replacements by providing the equipment with a durable protection by preventing disintegration and metallic deposits. It neither contaminates the solutions nor takes a plate. It can be applied to old as well as new plating racks. Minor abrasions can be easily repaired by the user. Re-coating can be handled best by a shop with complete facilities such as The Lea Mfg. Co. now has available.

Small Indicating Pyrometers

Thermo Control Devices, Inc., 1116 Milwaukee Ave., Chicago, offers two types of new small indicating pyrometers, Model F and Model C. They are ruggedly built, give continuous accurate service and are easy to install. They are furnished complete with lead wire and thermocouple, ready to use. They have a broad general usage and are sold at very low prices so that they may be applied wherever temperatures need checking. They are guaranteed for 1 yr. against defective material and faulty workmanship.

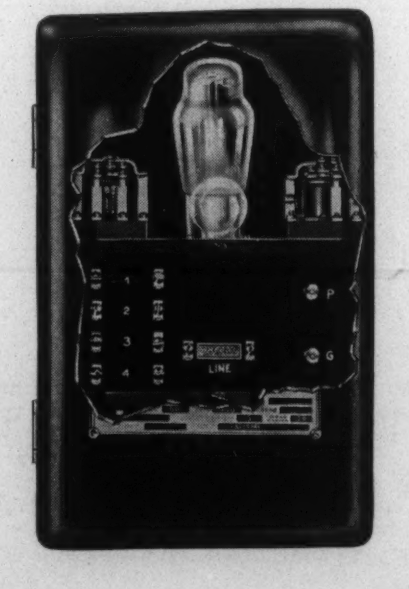


Both models are furnished in the following scales: No. 1—0 to 600 deg. F.; No. 2—0 to 1000 deg. F.; No. 3—0 to 2000 deg. F. and No. 4—0 to 2500 deg. F. Model F is furnished in black bakelite case and Model C in a handsome chromium finished case.

Flame-Otrol

The need for instantaneous flame control in industry, in order to prevent explosions due to flame failure, has led to the application of a well-known electronic principle which is dependent upon the flame itself. The "Flame-Otrol" is such an instrument, offered by Thermo Control Devices, 1116 Milwaukee Ave., Chicago. It is described as simple, positive in operation and as operating with split second speed.

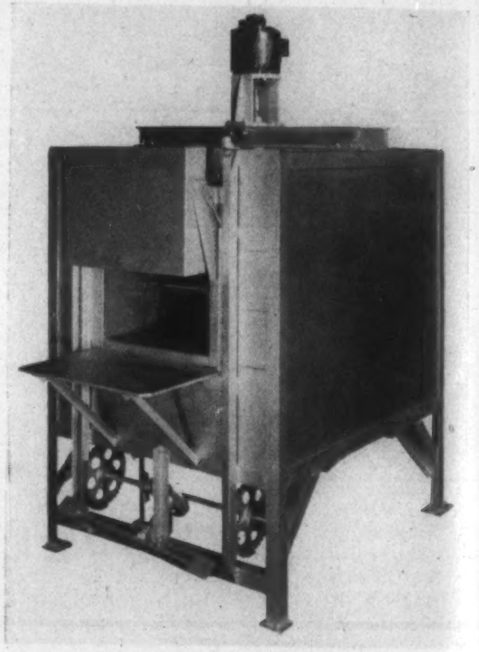
It is generally known that a flame maintained in atmosphere acts as a conductor, due to the fact that, when combustion takes place, ions or dissociated particles carrying electric discharges are liberated. This effect is taken advantage of in the Flame-Otrol wherein an electrode is placed within the flame, and conduction takes place between the electrode and pilot light orifice. The flame therefore can be likened to a switch which, upon disappearing, opens the circuit to a rugged long life vacuum tube, easily obtainable, which operates a dependable heavy duty relay to cut off instantaneously the fuel from the burners of any furnace.



New Air Tempering Furnace

The Cooley Electric Furnace Co., Indianapolis, Ind., has developed a new type of air tempering furnace that is designed for operations up to 1200 deg. F. The chamber is metal lined, alloy being used for the higher temperatures and steel for lower temperatures.

A high velocity blower type fan is employed, mounted in the top of the chamber, and it circulates the air around a baffle construction and through the work to produce uniformity of temperature. It has chamber dimensions of 18 in. wide by 13 in. high by 30 in. deep, the chamber being equipped with two removable shelves. One of the unique features of the furnace is the door operating mechanism consisting of a foot operated opening and closing device that eliminates counter weights and permits the door to remain stationary in any desired position. The door itself is of the plug type which insures sufficient insulation in the door, and tight sealing.



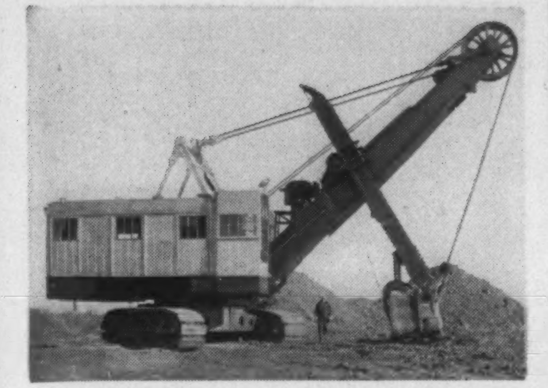
The furnace in the illustration is of 15kw. capacity for connection to 220 volt circuits, three phase. The elements employed are the "Doreco" elements, and are located in the lower part of the furnace chamber. They are so arranged that the air can pass rapidly over them and through the work. Because the resistors are protected from fumes, it is not necessary to clean the work before tempering in this furnace.

The elements are also so arranged that they are readily removable through the rear of the furnace, complete removal being accomplished in a few minutes. They are also so connected that reduced input switching is available to reduce the power from maximum to one-third its capacity. Failure of one or two in a unit would not require shutdown until a convenient time.

New Ward Leonard Excavators

A new series of Ward Leonard electric excavators, with capacities up to 4 cu. yds. is announced by the Harnischfeger Corp., Milwaukee. Complete one-man control for all operations in travel and steering as well as digging, is claimed combined with faster speeds, less weight and greater electrical horse power per pound.

In these machines, P&H designers have taken advantage of two basic developments: New alloy steels and arc welded construction to cut down inertia losses and speed up operations. Large members, such as boom and dipper sticks are of high tensile steel

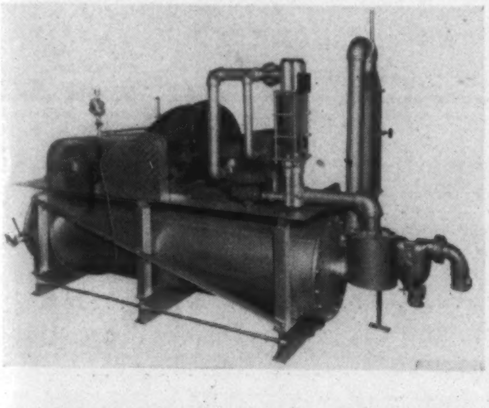


for lightness with greater strength. Cast frames have been discarded for lighter all-welded construction with structural steels.

Special emphasis has also been placed upon weight reduction in the more scientific placement of machinery units behind the center of rotation to balance the front end. Hence the machine requires less counterweight. Every motion in hoisting, crowding, swinging and traveling is powered by an independent motor.

Atmosphere Gas Producer for Annealing

The Atmosphere Gas Producer, built by the C. M. Kemp Mfg. Co., Baltimore, Md., has a capacity of about 6000 cu. ft. of treated gas per hour at 8 in. water column pressure. The non-oxidizing protective atmosphere produced is used in annealing furnaces for high grade sheets. It uses coke oven, artificial or natural gas, partially burning it with a predetermined quantity of air. The resultant treated and cooled products of combustion, from which water has been eliminated, is then delivered under pressure up to 15 in. water column to the furnace. The unit operates automatically and is equipped with an accurate air-gas proportioning mechanism which affords visible evidence of the air-gas ratio.



Aggregate to Withstand High Frequency Currents

The recent development of a special sand and gravel aggregate to withstand the effect that high frequency current has on foundation and construction work has been accomplished by George F. Pettinos, Inc., of Philadelphia. The use of this aggregate in the construction of high power radio transmitting stations has eliminated the heating of foundations caused by induction. This is mainly due to the fact that induction is not set up by the high frequency current on the minute particles of magnetic mineral found more or less common to all concrete aggregates.

This development will undoubtedly be a contributing factor towards the possible commercial use of higher frequency currents in the future.

FOR MAXIMUM OPERATING ECONOMY

. . .

SC
built this Batch-type Carburizer with Armstrong's Brick

Recently installed in the plant of the Tyson Roller Bearing Company, of Massillon, Ohio, is this Batch-type Carburizer constructed by the Surface Combustion Corp., Toledo, Ohio. Its efficiency is guarded with Armstrong's High Temperature Insulation.

SURFACE Combustion's Batch-type Carburizer, built for the Tyson Roller Bearing Company, Massillon, Ohio, brings a new conception of the fuel savings and operating efficiency possible with this kind of furnace. Estimated consumption of natural gas fuel is 364 C. F. H. for 1230 lbs. work and container, at a temperature of 1800° F.

In the construction of this high efficiency carburizer, Armstrong's Brick plays an important part. Walls and floors are built of 4½" Armstrong's EF-22 Insulating Fire Brick, backed by 2½" Armstrong's A-25 Insulating Brick and 4½" Armstrong's N-16 Insulating Brick. Arch construction is 9" Armstrong's EF-22 Insulating Fire Brick with a backing of 4½" Armstrong's N-16 Brick.

Use of Armstrong's EF Insulating Fire Brick permits thinner walls, with a consequent sharper furnace, shorter heating time, and a real saving on fuel costs. The panel at right lists the three Armstrong's Brick used in the Surface Combustion Batch-type Carburizer, and other Armstrong High Temperature Insulation products. For brief facts on all Armstrong's Brick ask for the new folder "Armstrong's High Temperature Insulation." Armstrong Cork Products Co., Building Materials Division, 982 Concord Street, Lancaster, Pennsylvania.

High temperature products in Armstrong's complete insulation line include:

ARMSTRONG'S N-16 INSULATING BRICK for temperatures up to 1600° F. behind the refractory.

ARMSTRONG'S N-20 INSULATING BRICK for temperatures up to 2000° F. behind the refractory.

ARMSTRONG'S A-25 INSULATING BRICK for temperatures up to 2500° F. behind the refractory.

ARMSTRONG'S EF-22 INSULATING FIRE BRICK. Light-weight semi-refractory brick for direct exposure up to 2200° F.

ARMSTRONG'S EF-26 INSULATING FIRE BRICK for direct exposure up to 2600° F.

ARMSTRONG'S V-18 BLOCK. Insulating block for use up to 1800° F.

Armstrong's
HIGH TEMPERATURE INSULATION

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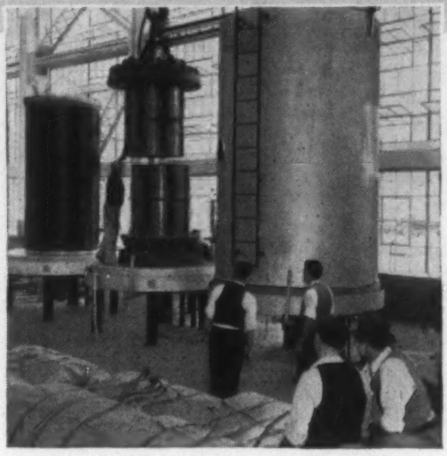
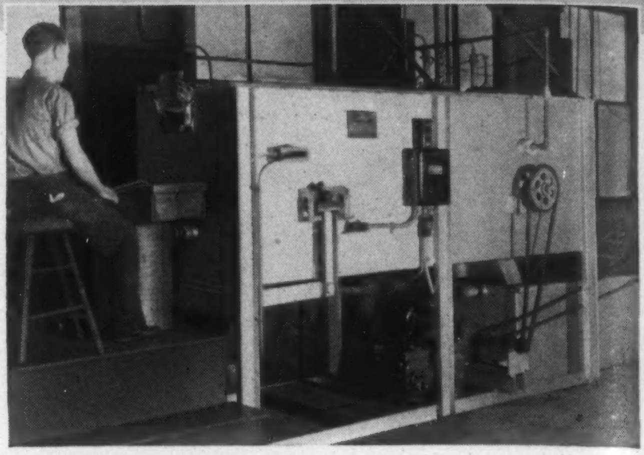
HELP THESE MANUFACTURERS

PRODUCTS AT LOW COST





Ford Buys 13 More G-E Bell-type Furnaces—Tests Show Quicker, Superior Annealing Is Obtained

The Ford Motor Company purchased thirteen more G-E bell-type bright-annealing electric furnaces when tests in its River Rouge plant showed these six distinct benefits:

1. A uniformly annealed product of superior quality.
2. Low over-all annealing costs.
3. A 45-hour annealing cycle—100 hours if other methods are used.
4. Lower maintenance, due to long life of resistors and inner covers.
5. Occupies 50-per-cent less floor space than other types of furnaces.
6. A clean, cool, and comfortable annealing floor.

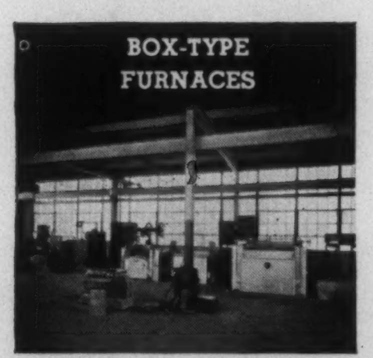
Write for our booklet "G-E Bell-type Furnaces," GEA-1495. Address General Electric, Dept. 6 B-201, Schenectady, N. Y.

Underwood Elliott Fisher Reduces Hardening Costs 50%, and Improves Quality, with Controlled-atmosphere Electric Furnace

Type bars, springs, links, and other small typewriter parts are scale-free hardened in this plate-belt, conveyor-type electric furnace. With it, Underwood Elliott Fisher has reduced hardening costs 50 per cent and has uniformly improved the quality of its product.

The furnace has controlled-atmosphere and properly distributed electric heat. Separate heat control for the region around the quench-tank chute assures that the parts being treated will be at exactly the right temperature at the instant of quenching. Both conveyor drums are within the hot zone, which assures good operating economy.

GET IT WITH G-E ELECTRIC FURNACES

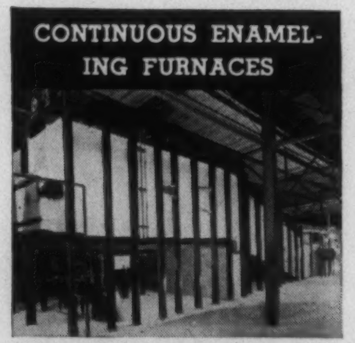


BOX-TYPE FURNACES

For run-of-the-mill heat-treating jobs

AIR-DRAW FURNACES

For drawing miscellaneous steel parts



CONTINUOUS ENAMELING FURNACES

For high-quality, low-cost enameling work

170-38

ELECTRIC

1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Gold Ore from the Edwards Mining Property at Lochalsh, Ontario. W. B. TIMM *et al. Canada Department of Mines, Mines Branch Report* No. 747, 1935, pages 10-13. Maximum extraction of Au was 97.5%. By flotation 95% of the Au was recovered. About 85% of the Au was recoverable by barrel amalgamation, only 65% when using plates. In hydraulic classification 60.2% of the Au settled out. **Gold Ore from the Pickle Crow Mine, Patricia District, Ontario.** Pages 14-21. Straight cyanidation extracted 99.2% of the Au. Barrel amalgamation recovered 93.9% and plate amalgamation 56.2% of the Au. Flotation recovered 94.7% and blanket concentration 87.1%. In the hydraulic classifier, 76.6% of the Au settled out; cyanidation of the overflow (0.265 oz. Au) gave a 0.005 oz. tailing. **Gold Ore from Casey Summit Gold Mines, Ltd., Summit Lake District, Ontario.** Pages 22-27. Over 91% of the Au was recovered by amalgamation. About 40% of the remaining Au was recovered by blanketing the tailing and amalgamating the concentrate. **Gold Ore from Lac des Millie Lacs property, Kashabowie, Thunder Bay District, Ontario.** Pages 44-48. Barrel amalgamation recovered 70% of the Au. Flotation followed by blanket concentration of the flotation tailing recovered 94% of the Au and 83.7% of the Ag. Cu makes cyanidation impractical. **Gold Ore from Pascalis Gold Mines, Limited, Pascales Township, Abitibi County, Quebec.** Pages 49-53. Cyanidation recovered 96.9% of the Au, barrel amalgamation 78.9% and flotation 98.7%. In the hydraulic classifier, 70.9% of the Au settled out in a product amounting to 8.1% of the feed. **Gold Ore from the Normont Gold Mine at Rouyn, Quebec.** Pages 64-70. Cyanidation recovered 95.2% of the Au; amalgamation 75%. Flotation gave a 3.52 oz. concentrate and a 0.01 oz. tailing with 98.4% recovery. Plate amalgamation recovered 45.0% of the Au; flotation of the tailings 52.5% more. Blanket concentration recovered 44.1%; flotation of the tails added 53.6% more. **Gold Ore from Montague Gold Mines, Limited, Montague, N. S.** Pages 71-78. Amalgamation recovered 77.5% of the Au and tabling of the tailing 17% more (the table concentrate contained 20% As). Cyanidation of the concentrate gave excellent recoveries. **Gold Ore from the Arntfield Gold Mines, Limited, Arntfield, Quebec.** Pages 111-116. Amalgamation and flotation of the tailing recovered 87.3% of the Au; cyanidation of the concentrate recovered only 85% of the Au, 74% overall. Au traps were not successful. Straight cyanidation recovered 86.7%. **Gold Ore from Little Long Lac, Geraldton, Ontario.** Pages 117-123. Amalgamation recovered 67.7% of the material; straight cyanidation 94%. Blanket concentration recovered 36-70%; amalgamation of the blanket concentrates 67-95% of the Au contained; cyanidation of the 2 tailings gave an overall recovery of 95.9%. **Silver Ore from White Eagle Silver Mines, Limited, Camsell River, Northwest Territories.** Pages 124-137. Crushing in stamp batteries followed by table concentration yielded a high-grade Ag concentrate with a high Ag recovery. Flotation of the tailing recovered 93.4% of the Ag in the tailing for an overall recovery of 98.92%. By barrel amalgamation of the table concentrate, 96.8% was recovered. By flotation of the amalgamation tailing 2.8% more Ag was obtained in a Pb concentrate carrying 384.6 oz. Ag/ton. **Gold Ore from the McWatters Gold Mine at Rouyn, Que.** Pages 152-155. Barrel amalgamation recovered 64.4% of the Au. Blanket concentration recovered 72.7%; amalgamation of the concentrate extracted 94.4% of the Au in the concentrate for an overall recovery of 68.6%. Cyanidation extracted 98.7% of the Au. **Gold Ore from Matachewan, Ontario.** Pages 156-166. Amalgamation gave 78% recovery at —65 mesh. Maximum extraction by cyanidation was 98%. Blankets saved approximately 80% of the Au; 81% of the rest was recovered by flotation making an overall recovery of 96%; cyanidation of the blanket concentrate extracted 98% of the Au. Straight flotation recovered 97% of the Au and cyanidation of the concentrate recovered 96% of that. **Gold Ore from Rochester Mine, Gillies Lake-Porcupine Gold Mines, Limited, Timmins, Ontario.** Pages 175-181. Traps and plate amalgamation recovered 74.83% of the Au; flotation of the tailings and cyanidation of the concentrate added 17.62%, an overall recovery of 92.45%; barrel amalgamation of the flotation concentrate recovered only 11.77%, an overall recovery of 86.60%; cyanidation of amalgamation tailings recovered 17.51% of the Au, 92.34% in all. **Gold Ore from McKenzie-Red Lake Gold Mines, Limited, at Red Lake, Ontario.** Pages 185-194. Cyanidation extracted 97.5% of the Au, plate amalgamation 62.3%, blankets 69.3%, flotation 86.6%, blanketing the flotation tailing 8.2% more. AHE (1)

Copper-Gold Ore from the Manitoba and Eastern Mines, Limited, Goward, Ontario. W. B. TIMM *et al. Canada Department of Mines, Mines Branch Report* No. 747, 1935, pages 4-6. Combined recovery by flotation followed by cyanidation was Cu 95.8%, Au 96%, and Ag 88.8%. **Gold Ore from B. C. Cariboo Gold Fields, near Moyie, British Columbia.** Pages 7-9. Cyanidation recovered 64% of the Au; 93% of the Au and and 95% of the Ag were recovered by flotation; the concentrate assayed Au 0.92 and Ag 3.6 oz./ton. **Gold Ore from Dikdik Exploration Company, Longlac, Thunder Bay District, Ontario.** Pages 54-59. Barrel amalgamation recovered 75% of the Au. Cyanidation recovered 97% of the Au and more than 77% of the Ag; recoveries in 24 hrs. were better than in 48 hrs. Flotation of raw ore or tailings gave high concentration. **Ore from the Howard Mine, Nelson, B. C.** Pages 60-63. Flotation recovered 96% of the Pb, 82% of the Zn, 60% of the Au and over 90% of the Ag in marketable Pb and Zn concentrates. Most of the Au was in the Pb concentrate. Au in flotation tailings was reduced to 0.025 oz. by cyanidation for an overall recovery of 95.8%. In floating a Pb concentrate, cyanide is used to depress Zn and Fe sulphides; it caused loss of about 10% of the Au in the ore. **Gold Ore from Amisk (Beaver) Lake, Saskatchewan.** Pages 138-142. From 2 very low grade weathered samples 52% of the Au was recovered by amalgamation; a higher grade weathered ore gave only 32.7% recovery. Cyanidation or flotation of fresh rock gave 93.1% extraction; barrel amalgamation 54%; flotation of amalgamation tailings an overall recovery of 92.6%. **Concentration and cyanidation of Greene Stabell Ore.** Pages 143-147. Fine grinding was necessary. Cyanidation extracted 91.8% of the Au, but due to Cu content, KCN consumption was 6-7 lbs./ton. A concentrate assaying 14 oz. Au/ton and 27% Cu was floated; the residue was cyanided to give 92.6% overall recovery with loss of only 2.7 lb. KCN/ton. **Gold Ore from Matachewan Consolidated Mines, Limited, at Matachewan, Ontario.** Pages 167-174. Amalgamation recovered 54.4% of the Au; flotation of the tailing added 30.4% more. Straight cyanidation extracted 94.4% of the Au. **Cyanidation and Flotation of Beattie Concentrate.** Pages 195-203. Extractions of 77.8-68.7% may be obtained by cyanidation; 55-88% of the Au in the tailings can be recovered in a flotation concentrate. Thorough washing prior to flotation is necessary. AHE (1)

■ 1a. Crushing, Grinding & Plant Handling ■

Further Notes on Power Used in Crushing. JOHN S. OWENS. *Bulletin Institution of Mining & Metallurgy,* No. 367, Apr. 1935, pages 1-21. Discussion. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 349L/3. AHE (1a)

Losses in the Concentration of Tin Ores in Bolivia (Over de Verliezen, die men lijdt bij het Concentreeren van Tinerts in Bolivia) P. S. BAKELS. *De Ingenieur,* Vol. 50, Nov. 22, 1935, pages M25-M29. The principal tin ore in Bolivia is cassiterite, SnO_2, which, when pure, contains 78% Sn but usually 55-65%. The dressing of the ore to free it from oxides, quartz, carbonates, magnetite, wolframite, and sulphidic materials is described, and the difficulties encountered because of local and geographical conditions are discussed. Ha (1a)

■ 1c. Flotation ■

Physical Chemistry of Flotation. VI. The Adsorption of Amines by Sulfide Minerals. ELSIE EVELYN WARK & IAN WILLIAM WARK. *Journal of Physical Chemistry,* Vol. 39, Oct. 1935, pages 1021-1030. Maximum contact angle is independent of the particular amine chosen, being within a few degrees of 60° for all amines. The amine induces a more or less permanent effect on the mineral surface, and it is concluded that adsorption of the amine is responsible for this. Of the minerals tested, the Cu minerals respond most readily, and pyrite least readily, to amines; activated sphalerite closely resembles chalcopyrite in its response. Using hexylamine, sphalerite can be floated away from galena. Of the amines tested, the quaternary ammonia salts are most readily adsorbed. The higher the homolog, the lower the concentration necessary for the mineral to respond, i.e. the ethylamines are more effective than the methylamines, the propylamines more than ethylamines, etc. The primary amines are the least active, the secondary amines are more active and the tertiary amines are still more active. Three cyclic amines—aniline, α-naphthylamine, and piperidine—are of about the same order as isoamylamine, but tribenzylamine is much more active. Contact tests which closely parallel actual flotation tests were carried out in identical solutions. 3 illustrations show how the contact induced at certain mineral surfaces by certain amines is prevented by addition of alkali or acid. (See also *Metals & Alloys,* Vol. 3, page MA 337 L-1; Vol. 4, page MA 373 L-6; Vol. 5, pages MA 114 L-5, MA 114 L-4, 114 L-6). EF (1c)

■ 1d. Magnetic Separation ■

Concentration and Reduction Experiments with Iron-rich Bauxites (Aufschliess- und Reduktionsversuche mit eisenreichen Bauxiten) J. SZEKI & A. ROMWALTER. *Royal Hungarian Palatin-Joseph University of Technical & Economical Sciences, Faculty of Mining, Metallurgy & Forestry of Sopron,* Vol. 7, Part 1, 1935, pages 42-51. Hungarian bauxites are usually rich in Fe and contain appreciable amounts of SiO_2 and TiO_2. Experiments are described to find means to separate Fe and Al by magnetic separation. No great success attended the tests, however, as these bauxites contain the Fe and Al constituents in a homogeneous colloidal dispersion which was not amenable to magnetic separation even after a reduction of the Fe oxides. More practical and economical success seems to be obtainable by the usual wet process and by a reducing soda process with coal as thereby sponge iron and Al oxide are produced in one heating process. The experiments with the attending chemical reactions are described in detail. 8 references. Ha (1d)

■ 1e. Amalgamation, Cyanidation & Leaching ■

Present Status of Gold Mining in Roumania (Der gegenwärtige Stand des Goldbergbaues in Rumänien) R. EICHELTER. *Montanistische Rundschau,* Vol. 18, Jan. 1, 1936, pages 1-9. Up to 1930 80% of Au produced in Roumania was treated by amalgamation; in 1932 this figure had dropped to 65.4% as a result of the introduction of flotation methods. The author reviews the most important mines and mills. The most common method was to produce an auriferous pyrite concentrate which was smelted in the so-called "Pilz" furnaces. Lately this method has given very much trouble due to the high Zn content of these concentrates (6-12% Zn), and much effort has been expended to improve the selectivity of the flotation. A high Pb content in the charge also improves smelting conditions. The Balta plant one of the most modern plants in the country operates on an ore containing 7-15 g. Au/ton and 40 g. Ag/ton. This is concentrated in 2 steps, producing a concentrate with 300-400 g. Au/ton, and practically all of the Pb. About 90% of the Au is recovered in this concentrate which is easy to smelt. A pyritic concentrate, low in Au is also obtained. This is treated by cyanidation, increasing the Au recovery to 93-95%. A new precious metals refinery using the Siemens-Halske-Pfanhauser process has recently been completed at Baia Mare. This plant has an annual capacity of 6000 kg. Au and 18,000 kg. Ag. The article is a good summary of the Roumanian Au situation. BHS (1e)

Metallurgical Efficiency on the Sub Nigel. G. CARLETON. *South African Mining & Engineering Journal,* Vol. 46, part II, Oct. 19, 1935, page 197. The new reduction plant at the Sub Nigel Mine has reduced tailing values to 0.24 dwt./ton (formerly 0.37) for an extraction of 98.5% (97.9% previously). Costs (including sorting and crushing) are 3s. 3d./ton. About 55% of the ore value is extracted on corduroy. Overflow from bowl classifiers is cyanide feed. AHE (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

2a. Non-Ferrous

Smelting in the Lead Blast Furnace. Handling Zinciferous Charges. XI.—Preparation of the Charge by Sintering. G. L. Oldright & Virgil Miller. *United States Bureau of Mines, Report of Investigations* No. 3243, Dec. 1934, 60 pages. The feed to the sintering plant in Sept. 1931 averaged Cu 0.26, Pb 44.69, Zn 8.54, S 11.71, SiO_2 6.65, Fe 11.99 and CaO 3.33%. The material is given 2 roasts, the first on 6-600″ machines and the second on 2-600″ and 6-264″ machines. The charge is 450 lbs./pallet, depth 6″, pallets moving at 30″/min. in the first roast and 800 lbs., depth 11″, in the second roast, pallets in the short machines moving 9″ and in the long machines 19″/min. Over 80% of the charge to the first roast is wet material, Pb flotation concentrates, part of the flue dust, and Zn-plant rejects and residues. The flotation concentrate contains about 10% moisture. Mineralogically it is largely galena, pyrite and sphalerite. The Zn-plant residue contains 29% moisture; some is kiln dried to 12-18% H_2O; little H_2O is lost on standing. The drier material acts as a sponge in drying the wetter ingredients. A study of the variation in composition and size of feed to 15 pallets in the first roast, showed a variation in sulphide S from 9.6-7.9%, while + ½″ material increased from 22.4 to 38.6%. There is a maximum concentration of 3.5% SO_2 leaving the cake 20 ft. from the dead plate, and falling off rapidly in both directions. The maximum temperature, 1020°, was attained after 35 ft. of travel; the maximum rate of increase was shortly after the maximum SO_2 concentration had been attained. Volume of air increased regularly toward the end. Data are given tabularly on the effect of size and chemical composition of the charge on the gas evolution and composition of the sinter. Extensive data are given on the effect of several variables in feeding and distributing the material on the pallets for the second roast. This feed varies less in chemical composition than the feed to the first. Variations in particle size are about the same. Extensive data are given on the size and composition of feed to the second roast, volume of air, and temperature and analyses of gases for both 7″ and 11″ beds. Maximum SO_2 is 7.7% about 4 ft. from the dead plate. The temperature at the top of the cake begins to rise abruptly at 2 ft. and goes to a maximum of 830° at 3 ft.; the temperature in the center rises precipitously between 4 and 6 ft. where the maximum is 1040°; at the bottom the rise is parallel to the others, reaching 1040° maximum at 10 ft. Volume of air rises gradually from 42 ft.^{3}/ft.^{2} of grate area next the dead plate to 160 ft.^{3} after 20 ft. of travel. The machines produce more sinter with the thinner cake and the sinter is harder, but upkeep is less for the slower speed machines (thicker beds). Between 1931 and 1932, the amount of flue dust in the charge decreased, causing less S removal in the first roast and greater return of sinter to the first feed; Pb decreased 5%; Zn-plant residues were increased. Richer gases were made in 1931. The temperature of the cakes rose more slowly in 1932 and stayed hotter longer. Pallet speeds were decreased to cool the sinter sufficiently to discharge safely. In an 11″ cake containing 7% moisture, rate of propagation of flame downward was about right. The nature of the material sintered, the depth of the bed and the best moisture content are all interrelated. Freshly Cottrelled fume from the Pb blast furnace was the most effective material to add to the feed to the first roast to obtain a product that would retain enough moisure when fed to the second roast. The same weight of oxidized or burned flue dust would not give the same results. Returned sinter is a drying agent of particular value when the charge is wet; it also regulates S content of charge and supplies coarse material to the bed. Recirculation of air from the last 4 ft. through the first 7 ft. gave a hotter gas with less O_2 than normal; the cake fused more readily. Solids in the gas were reduced. The short machines usually produced a somewhat larger tonnage of sinter per ft. of length of machine. If there is less than 5.5% S in the feed, there is not enough heat to fuse the cake well. A well-fused cake contains 1.5% S. **XII.—The Gases within the Blast Furnace at Top and Tuyeres.** *Ibid.* No. 3244, 22 pages. The blast furnace charge was 2550 lbs. of sinter, 200-400 lbs. of slag shells and cleanings, 100-300 lbs. Zn-plant residue, some filter cake of material originating from the humidifying flues of the blast furnace, a few lbs. of refinery byproducts (Sb slag, etc.), metallic Pb from D.L. wind boxes, dry dross, SiO_2 (occasionally) and 10% coke. The range and average composition of gases evolved at 21 locations over the surface of the charge in 2 furnaces and the change in composition with time after charging (1 min. intervals) are shown tabularly. H_2 was less than 0.1%. The average composition of gases at the slag tap end was CO_2 11.2, O_2 7.9, and CO 4.5%; in the center, CO_2 19.7, O_2 1.9, and CO 5.9%; at the far end CO_2 15.1, O_2 5.8, and CO 4.6%. SO_2 from front to back in 1 furnace was 0.046, 0.023, 0.018, 0.380, 0.230, 1.220 and 0.570%. Maximum temperatures at each of the 21 gas sampling points on 1 day were 60-695°. Blow holes cause local high temperatures at the surface. Feeding wet material encourages greater irregularities in the temperature of gas evolved at the surface of the charge, which temperatures are related to the shape and size of accretions in the shaft and to the method of charging. Normally the amount of flue dust was directly proportional to the temperature at the surface of the charge. Temperatures and gas compositions at the tuyeres are given tabularly. The more coke the higher the temperature. Less resistance was offered to gas passage when more coke was used, hence more air entered the furnace. The more uniformly the coke was mixed with the charge and the more steadily the charge moved down the shaft of the furnace, the less was the fluctuation of the temperature at the tuyeres. The gases at the tuyeres had relatively little reducing power. Their O_2 was high and CO low; an average for the central point was CO_2 10.5, O_2 3.9, CO 13.8, N_2 71.8% and H_2 trace. Less O_2 was removed from the charge by the reducing gases at the plants with richer Zn slags. One of the main effects of more than 15% Zn was to raise the elevation of the zone of highest reduction. **XIII.—Accretions at Various Elevations within Blast Furnace, and Factors Governing Manner and Rate of Descent of Stock Column.** *Ibid.* No. 3245, 15 pages. The charge descended at the rate of 1½″/min.; the fastest rate recorded was 10″/min. "Hangs" were more likely to happen when the feed was fine, the tuyere zone was hot and the slags were rich in Zn. Normally the slag contained 4% Pb. ZnS and S were greater in the accretions than in the sinter; they were greatest at the lowest levels. More slag-forming ingredients are present in accretions next to the charge. Accretions next to the jackets were enriched in ZnS. Accretions are thickest near the top and grow thinner in lower levels of the shaft. More accretions were made when there was more S and coke in the charge. The Zn-plant residue from leaching fume contributes generously to formation of accretions. There is little free space in the crucibles after a few weeks operation. There are more slag forming constituents toward the top of the crucible. **XIV.—Methods of Charging the Blast Furnace. Their Effect on Furnace Operation.** *Ibid.* No. 3246, 12 pages. Distribution of charge under different methods of loading and discharging car and use of different types of baffles were studied in bins simulating a blast furnace. The results, applied to operating furnaces, showed that when the ingredients of the charge were properly distributed as to size and composition a lower smelting column could be employed and a greater capacity obtained. Use of wet residue decreased smelting rate and increased Pb in the slag. **XV.—Slags from the Trail Blast Furnace.** *Ibid.* No. 3246, 19 pages. Molten slag is held in a "slag-holding furnace"; a mush, constituting 20% of the slag, settles out; it analyzes Pb 6.9, Zn 15.3, S 0.9, Fe^{++} 15.9, Fe^{+++} 16.1, SiO_2 13.9 and CaO 6.4%. Analyses of 60 slag samples showed that Pb in the slag increased with an increase in the amount of Fe^{+++} and decreased as S increased. The Oct. 1931 composite slag sample analyzed Cu 0.19, Pb 4.35, Zn 18.0, S 1.4, SiO_2 18.7, Fe 28.9, CaO 7.80, Al_2O_3 3.70, MgO 1.20, Mn 0.99, Sb 0.07, As 0.05, and Bi 0.002, total 85.35%. The temperature of the slag is 1110°-1220° and of the bullion 720°-1010°. There is but little relationship between the lengths of time ordinarily elapsing between periods of tapping the furnace and the temperature of the slag. Any differences in the amount of Pb in slags remaining 3-27 minutes in the furnace were so obscured by other variables as to be unnoticeable. The Pb in all the slags except in freshly smelted accretions is present largely as metal. Part of the metal is oxidized if the sample is granulated in H_2O. The most acidic slags gave the smallest percentage of total Pb present as metal. AHE (2a)

Beryllium (Le glucinium ou béryllium) *Journal du Four Electrique*, Vol. 44, Nov. 1935, pages 392-394. Beryl consumption in 1935 averaged about 40 tons a month. Beryl is heated with sodium fluosilicate at 650°-700° C. which transforms Be into soluble $NaBeF_3$. Beryllium Corporation and Deutsche Gold und Silberscheideanstalt precipitate BeO from this with soda, chlorinate the latter in the presence of C at about 1000° C. and electrolyze $BeCl_2$ produced in molten state in the presence of NaCl. Electrolysis is conducted in H_2 atmosphere at 730°-820° C. by the Beryllium Corporation and at 430°-450° C. by the Scheideanstalt. Siemens und Halske convert BeO into oxyfluoride which is electrolyzed at 1400° C. in the presence of BaF_2. Compagnie Alais, Froges et Camargue decomposes $NaBeF_3$ with fluosilicic acid in the presence of SiO_2 producing BeF_2 and sodium fluosilicate which is reused. Solution of BeF_2 is evaporated and baked at 300° C. producing $2BeO.5BeF_2$ which is electrolyzed at 1400° C. in a bath containing BaF_2. Water cooled steel cathode is used. Alloys of Be can be prepared either by introducing a corresponding fluoride in the bath or by adding the metal directly to it. JDG (2a)

Extraction of Vanadium from Kertch Slags. M. B. Zapadinski. *Kachestvennaya Stal*, No. 9, 1935, pages 56-58. In Russian. Sintering slag with NaCl and leaching with H_2O extracts 60% of V_2O_5. Calcining crushed slag at 900° C. converts 90% of its V into such a state that it is soluble in 8% H_2SO_4. No heating is required for solution. Repeated leachings of fresh portions of roasted slag brings V concentration to 20 g./l. It is impossible to precipitate V_2O_5 directly from this solution. About 3% of raw slag is added to the solution; H_2 and H_2S is liberated reducing V_2O_5 which is precipitated by neutralization of the solution with 1.5-3.0% NaOH. The product contains about 15 times as much V as the slag. Precipitate obtained is dried, heated at 300°-400° C. to oxidize V and leached with 5-10% NaOH. Solutions obtained containing 40-50 g./l of V_2O_5 are treated with 8% H_2SO4 and boiled, which precipitates V. It is washed free from P. Instead of regulating acidity a catalyst, not described in the paper, can be used. (2a)

New Methods for Obtaining Magnesium (Neue Wege zur Gewinnung von Magnesium) Willy Machu. *Metall und Erz*, Vol. 32, Dec. 1935, pages 565-570. The commonly used process for obtaining Mg is the electrolysis of molten dehydrated $MgCl_2$. It is costly because it is difficult to dehydrate the $MgCl_2$ and to prevent volatilization of Mg. Reduction of Mg salts by Na, K, Ca, Al Si, ferro silicon, and Ti is too costly as it is impossible to recover the reducing agents. Reduction with C was at first unsuccessful because Mg forms as a dust at high temperatures and the reaction is reversible. The dust cannot be melted into solid metal under ordinary conditions. A process has been patented for quickly cooling the vapors containing metallic Mg, MgO and impurities in an inert atmosphere, then heating at reduced pressure in H_2 to melt the metal slightly above its m.p. In another process the dust formed by C reduction is heated in a rotary furnace in the absence of air with a tumbling action to above the m.p. It is best to keep the dust above 2000° C. until it emerges from the reduction furnace, then cool it quickly in H_2. The dust can also be distilled *in vacuo* and condensed with drops of a light mineral oil. Mg of high purity separates from the oil. A direct process has been developed in which sintered magnesite, dolomite, or MgO is heated with Al or Si and an inert gas in a continuous furnace to above the m.p. The vapor formed is passed with a reducing gas through a condenser and cooled to the liquid state. This process has been tried out on a semi-production scale. CEM (2a)

2b. Ferrous

Rig for Operating Blast Furnace Bell Reduces Weight on Top Structure. *Steel*, Vol. 98, Feb. 3, 1936, page 58. Brief description of mechanism for operating big bells, developed by Arthur G. McKee & Co. Big bell beam has been eliminated, thus obviating use of numerous counterweights. Bell rod is hung and driven from a heavy sheave wheel and crank-shaft which operate directly above. With this rig, bell is centered more easily; load on top structure is reduced; factor of safety is enhanced; movement of bell is better controlled; positive force for opening and closing is provided; and smaller hoist can be used. MS (2b)

3. MELTING, REFINING AND CASTING

Testing of Molding Materials with Respect to Their Pouring Strength by Employing Trial Specimens for Iron, Steel, Malleable and Non-Ferrous Metal Foundries (Die Prüfung von Formstoffen auf ihre Giessfestigkeit unter Anwendung von Probekörpern für die Eisen-, Stahl-, Temper- und Metallgiessereien) L. Treuheit. *Giesserei,* Vol. 22, Dec. 6, 1935, pages 601-603. Present methods of testing molding materials as to their strength and resistance against the forces occurring in pouring are not of great practical value. A new process is described which uses trial pieces of different shape and wall thicknesses. These pieces are molded and cast and the behavior of the molding material used is studied with regard to plasticity, humidity content, gas permeability, fire-proofness, binding ability, and with different coatings (graphite, etc.). In this way, more directly applicable results are obtained for the practical founder. The intended standardization of molding and core materials should be extended to mixtures of molding sands for different castings on the basis of such tests. Ha (3)

Recent Developments at the Dagenham Foundry of the Ford Motor Company, Limited. Vincent C. Faulkner & J. N. Burns. *Foundry Trade Journal,* Vol. 53, Dec. 26, 1935, pages 465-466. An appendix to a paper read before the Lancashire Branch of the Institute of British Foundrymen. Rotary melting furnaces, molding, fettling department, etc., are discussed by the authors. AIK (3)

Modern Foundry Practice. W. G. Morgan. *Journal Institution of Production Engineers,* Vol. 14, Sept. 1935, pages 480-494. Includes discussion. In the cast Fe foundry, attention to the molding sand, the use of the balanced draft and preheated air cupolas, and the use of alloy cast irons are important recent developments. Improved melting methods to avoid gas inclusions in non-ferrous metals and the use of centrifugal and die-castings are briefly noted. JCC (3)

Economy of Plywood in Making of Patterns (Von der Wirtschaftlichkeit des Sperrholzes im Modellbau) R. Löwer. *Giesserei,* Vol. 22, Jan. 20, 1935, pages 630-633. Examples show that by using the more expensive plywood instead of ordinary wood considerable savings in material and even in the cost of a pattern can be made. Ha (3)

Pouring Time and Sections for Pouring (Temps de Coulée et Section d'Attaque) Guy Hénon. *Revue de Fonderie Moderne,* Vol. 29, Dec. 25, 1935, pages 375-380. Determination of the best time for filling a mold and of the required sections of gates and risers to accomplish the former is discussed and a few general rules are given which permit selecting time and sections in accordance with the dimensions of the casting. Examples are calculated. 8 references. Ha (3)

3a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

New Compound Casting Process for the Manufacture of Pistons, Especially of "Refractory" Pistons (Neues Verbundgussverfahren für die Herstellung von Kolben, insbesondere "feuerfester" Kolben) G. Gressenich. *Automobiltechnische Zeitschrift,* Vol. 38, Dec. 25, 1935, pages 623-625. The difficulties of producing a piston with equally good wearing and heat resisting properties and the means to approach this end by various methods are explained. No generally satisfactory results have so far been obtained. A new process devised by E. Mahle (DRP applied for) is described in which the engine piston is made of two or more light metal alloys of different quality which are cast together in such manner that they are poured as simultaneously as possible at a temperature which favors the combination of the 2 alloys. In this manner each of the piston parts, bottom and shaft, is made of that alloy most suitable for service. The border zone of an intermediary alloy is formed which will stand the mechanical stresses and at the same time assimilate the opposing properties of the two alloys. Ha (3a)

Sand Problems in a Brass Foundry. F. Howitt. *Metal Industry,* London, Vol. 47, July 5, 1935, pages 8-12; July 12, 1935, pages 37-40. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 484R/4. HBG (3a)

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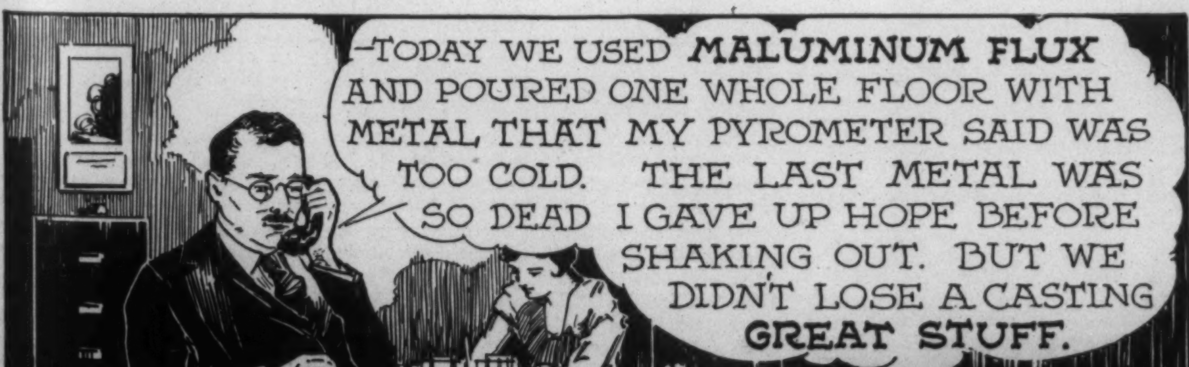
Nickel Progress During the Last Decade (Le progrès du nickel au cours de ces dix dernières années) John F. Thompson. *Revue de Métallurgie,* Vol. 32, Nov. 1935, pages 509-517. Survey of recent advances. Frood mine in Sudbury district contains more than 135 million tons of ore, is 2,800 feet deep and yields 10,000 tons daily. Ore is ground and subjected to flotation. Gangue is eliminated and Cu rich and Ni rich portions separated from each other. Ni rich portion is roasted in Herreshoff furnaces placed above the reverberatories into which the hot calcines are fed. They are run to produce a 25% Ni matte and a slag with 35% SiO_2. Matte is blown in Pierce-Smith convertors to contain 42% Cu, 37% Ni and 20% S. Converter slags go back to reverberatories. Tops and bottoms process (Orford method) depends on the solubility of CuS in Na_2S which is obtained by roasting $NaSO_4$ with C and matte. Dissolved Cu floats on the top of NiS and is easily separated from it after cooling. Bottoms are crushed, washed and sintered. This sinter is melted with C and cast into anodes. The latter are placed in electrolytic cells in cloth bags serving as membranes. Pure Ni solution is pumped into them, containing only $NiSO_4$ and boric acid. On leaving cells the solution is freed from Cu by Ni powder addition and Fe is removed by converting it into ferric hydrate and filtering off. At Clydach (Wales) Mond process is applied to roasted and reduced bottoms producing 99.9% Ni free from Co. Statistical data on uses of Ni are given. 47 references. JDG (3a)

Continuous Production in the Foundry. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 42-44. The use of conveyor systems in aluminum foundry practice is briefly discussed. JCC (3a)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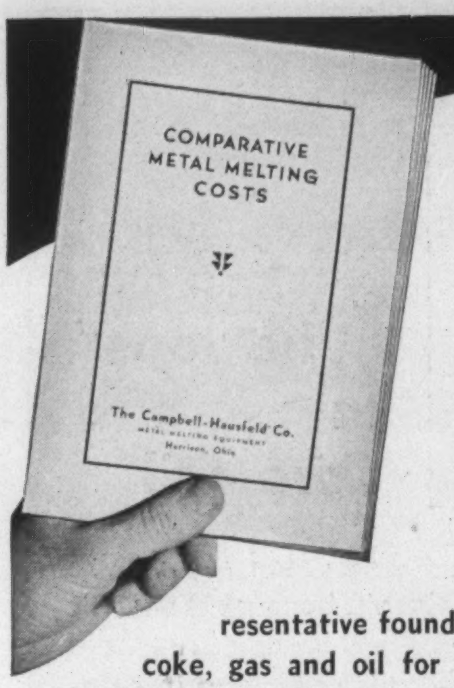

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The Bessemer Converter. Present Position in Non-Ferrous Metallurgy. H. R. Potts. *Metal Industry,* London, Vol. 47, July 19, 1935, pages 55-57. In 1880 Cu metallurgists adopted the Bessemer principle for the elimination of impurities by oxidation. In ferrous metallurgy only a few percent of impurities had to be eliminated but in the case of Cu as much as 80% of the low grade matte, such as S, and Fe, with smaller quantities of Sb, As, Bi, etc., had to be removed. The application of the Bessemer converter revolutionized the Cu smelting industry and, as yet, no competitive process has supplanted it. The molten Cu-matte, composed chiefly of Cu- and Fe-sulphides, was blown until all of the Fe, S, and other impurities were eliminated and only metallic Cu remained. The method employed is indicated. Basic-lined converters in use today are either the upright or Great Falls type of the horizontal or Pierce-Smith type. Basic converters are an important factor in the enrichment of the Cu-Ni matte in Canada preparatory to the extraction of these metals by the Mond or Hybinette processes. HBG (3a)

Large Automotive Die Castings Upset Predictions as to Commercial Ranges. L. M. Waite. *Iron Age,* Vol. 136, Nov. 7, 1935, pages 31-33. Describes various automobile grilles made by Doehler Casting Co. Limitations as to size of die castings have been greatly reduced. Barely 2 years ago restrictive size range limits were placed on future die castings. VSP (3a)

Die Casting. A. H. Mundey. *Foundry Trade Journal,* Vol. 53, Nov. 21, 1935, pages 383-386; *Machinery,* London, Vol. 47, Dec. 5, 1935, pages 277-281. See "The Die Casting of Non-ferrous Metals," *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 3L/1. AIK + WB (3a)

Production, Properties and Uses of Refined Aluminum (Etude sur la fabrication, les propriétés et les emplois de l'aluminium raffiné) Robert Gadeau. *Revue de Métallurgie,* Vol. 32, Nov. 1935, pages 503-508; *Metallurgist,* Dec. 1935, page 94. Refining process used by Alais, Froges et Camargue Co. (French 759,588) differs from Hoopes' method in having cell walls made of magnesite bricks and replacing BaF_2 in the electrolyte of the former with $BaCl_2$. This permits keeping all electrolyte molten and working at 700°-750° C. Magnesite bricks do not contaminate Al with Fe after few hours of operation. Majority of the product averages 99.995% Al and the highest purity obtained until now was 99.9986% Al. Cast 99.99 Al metal has 45% elongation and 5 kg/mm.^{2} tensile strength; sheets annealed 3 hours at 350° C. have 55-60% elongation and tensile strength of 5.5 kg/mm.^{2} Cold worked 99.996% metal has electrical conductivity equal to 65% of Cu and in annealed state 65.2% of Cu. Corrosion resistance rapidly increases with impurities, 99.99% metal loses 0.06 g./dm. in 16 hours when kept in concentrated HCl at room temperature. JDG + VVK (3a)

Overcoming Gas Conditions in Phosphor Bronze. M. T. Ganzauge. *Foundry,* Vol. 63, Nov. 1935, pages 32-33, 70, 73. Deals with work involved in casting P-bronze cylinder lining approximately 3 ft. long and 1½ ft. in diam. Ingot metal used consists nominally of 80% Cu, 10% Sn, 10% Pb and 0.10% P. Considers results produced under neutral, oxidizing and reducing furnace atmosphere. Illustrates molding forms. VSP (3a)

Secondary Brass Melting—A Review of Modern Practice. *Metal Industry,* London, Vol. 47, Aug. 2, 1935, pages 107-108. The furnaces available for brass melting are (1) crucible, coke-, oil- or gas-fired, which are used for small melts of known composition, for which each type of fuel has its particular advantage; (2) small oil-fired furnaces, which while of only 1½-2 ton capacity have the advantage that the Zn-loss is approx. half that of the reverberatory furnace; (3) electric furnaces, which have the advantages (a) long life of lining, (b) greater capacity than crucible furnaces, (c) no possible contamination by furnace gases, (d) small loss of Zn (approx. ½% in suitable types of furnaces), (e) close control of temperature; and (4) reverberatory furnaces with the advantages of capability of producing large melts, uniform in composition, from diversified raw material, possibility of charging large pieces, low fuel and labor cost, and comparatively low lining cost. The Zn-loss is higher (approx. 5%). The disadvantage of the large surface area of metal exposed to oxidation or contamination is used to advantage when purification is effected by slag "washes". In a general description of design and construction of reverberatory furnaces the "burning-in" of the hearth is discussed and means for tapping are suggested. The operation of the furnace is briefly considered. In discussion of furnace atmosphere it is pointed out that the refiner of the future will have to keep his atmosphere consistent due to the impurities present. It is stated that Sn-oxide is not wholly reduced by Zn and that ZnO, when formed, being so slightly soluble in the metal is not influenced by a subsequent reducing atmosphere. Temperature control is of major importance in the production of gas-free metal. In considering deoxidation the differences of opinion of investigators relative to the method by which P functions, i.e. whether its action is chemical or mechanical, is noted. The present lack of knowledge of the mechanism of "purifying fluxes" is deplored and the advantages to be obtained from research in this field are indicated. HBG (3a)

Metal Melting—Its Effect on Quality. H. W. Brownsdon. *Metal Industry,* London, Vol. 47, Sept. 13, 1935, pages 252-262; *Engineer,* Vol. 160, Sept. 13, 1935, pages 277-278; Sept. 20, 1935, pages 286-289; *Engineering,* Vol. 140, Sept. 13, 1935, pages 282-283. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 2R/2. LFM + HBG (3a)

Non-ferrous Casting Alloys. Symposium on Deoxidation and Degasification. I. General Principles. C. H. Lorig. **II. Deoxidation and Degasification of Red Brass.** Committee Report. *Metal Industry,* London, Vol. 46, May 17, 1935, pages 530-534, 543. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 484R/1. HBG (3a)

The Pressure Die-Casting of Alloys. Ladislav Jenicek. *Metal Industry,* London, Vol. 47, Oct. 25, 1935, pages 411-416. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 350R/3. HBG (3a)

Further Suggestions Covering Costs in the Melting and Moulding Departments of a Gray-Iron Foundry. *Foundry Trade Journal,* Vol. 53, Dec. 26, 1935, pages 466-468. Suggestions by the Casting Sub-Committee of the Institute of British Foundrymen. Melting costs, direct and indirect casts in molding department, etc. are discussed. AIK (3a)

Recommended Practice for the Common Aluminum-Copper Alloys. *Foundry Trade Journal,* Vol. 53, Dec. 19, 1935, pages 454-455; Dec. 26, 1935, pages 471-473. Abstracted from the report of the Non-Ferrous Division Committee on recommended practices of the American Foundrymen's Association. AIK (3a)

Die Castings Increase in Size. *Steel,* Vol. 98, Jan. 6, 1936, pages 224, 325-327. Gives views of various authorities relative to progress in the die-castings industry in 1935. MS (3a)

Bullion Parting at the Homestake Mine. Nathaniel Herz. *Mining & Metallurgy,* Vol. 16, Dec. 1935, pages 500-504. Describes bullion parting by the Homestake Mining Co. The method selected was the Miller or Cl process, which consists of passing gaseous Cl into bath of molten bullion, converting all metals other than Au into chlorides, and removing them. Electrolytic and acid parting processes were rejected as unsuitable. Au contained in AgCl is recovered by remelting Ag Cl under borax cover and reducing Ag by addition of soda ash. Cu is removed by leaching with $FeCl_3$. Includes a flow sheet of Homestake parting plant. VSP (3a)

Capacity of Aluminum Casting Alloys to Fill the Mold (Das Formfüllungsvermögen von Aluminium-Gusslegierungen) R. Irmann. *Aluminium,* Vol. 18, Jan. 1936, pages 9-13. Capacity of pure metals to fill the mold, beside depending on the interior friction of the metal, depends mainly on its specific heat and the latent heat of fusion. Multiple alloys have very complex conditions. The liquidity increases linearly with increasing temperature of the metal. The method to determine the degree of liquidity by casting specimen spirals is described; for 350° C. temperature of the chill mold and 700° C. of the metal, the following order of liquidity was found: silumin, peraluman 7, anticorodal, alufont II, German alloy, peraluman 2. This order changes with other temperatures. A curve illustrates the behavior of these different Al alloys between 650° and 800° C. Ha (3a)

Aluminum Castings (Aluminiumguss) R. Irmann. *Aluminium,* Vol. 18, Jan. 1936, pages 2-8. Conditions required to produce good "pourability" of Al and its alloys are discussed; the principal factors are liquidity so that the mold is filled easily and completely, formation of pipes on solidification, hot-shortness shortly after solidification, and shrinkage in solid state. Liquidity is determined by the length of spirals cast in chill molds; the more often the metal is remelted the more the liquidity is lessened, and the slower the metal can solidify in the mold the greater is the liquidity. High casting temperatures and dry sand or preheated chill molds are recommended. Melting procedure, melting furnaces, separation of slag from the metal, molds, casting, cleaning and testing of castings are described at length. Ha (3a)

Few Changes in Lead Metallurgy Reported. Carle R. Hayward. *Mining & Metallurgy,* Vol. 17, Jan. 1936, page 23. Practically all Pb plants are treating scrap materials particularly battery plates. Perfecting of selective flotation and improvement in sintering had profound effect on Pb smelting industry. Considerable interest in Pb smelting in Russia has stepped up production rapidly. In Australia the continuous softening and desilverizing operations are working satisfactorily. Modification of Betts electrolytic refining process has been developed. VSP (3a)

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3b. Ferrous

C. H. HERTY, SECTION EDITOR

Comparative Investigations of the Effect of Special Deoxidation Agents with Soft Steel (Vergleichende Untersuchungen über die Wirkung von Sonder-Desoxydationsmitteln bei weichem Flussstahl) P. ZIMMERMANN. *Mitteilungen der Kohle- und Eisenforschung G.m.b.H.*, Vol. 1, No. 3, 1935, pages 29-48. The various deoxidizers for steel have a decided influence on segregation, number, size and distribution of non-metallic inclusions, pipe formation and tendency to aging. The deoxidizers used preferably at present are:

	% Mn	% Si	% Al	% Ca	% Ti	remainder Fe
ferrosilicon	—	76.12	—	—	—	23.88
calcium silicon	—	55.84	—	29.25	—	14.91
feralsite	—	36.50	19.05	—	1.32	43.13
simanal	19.44	20.95	16.16	—	1.50	31.95
alsimine	—	34.10	44.74	—	2.88	18.28
Al	—	—	98.50	—	—	1.50

The most effective was alsimine which produced a melt with high Si, and the steel showed few inclusions and the least pipes; there were, however, some alumina inclusions. A similar effect was obtained with siminal. All agents reduced segregations, inclusions were higher for ferrosilicon and calcium silicon than for the others; calcium silicon gave only small and uniformly distributed inclusions in the ingot, and killed the steel completely without addition of Al. The S content was not reduced with this deoxidizer. The least effective deoxidizer was pure Al; it showed the most numerous and coarsest inclusions in very irregular distribution and the most segregations. When added together with ferrosilicon, the action is still unfavorable but less than with pure Al alone. Compared with non-killed soft steel melts, all melts treated with additional deoxidizers showed deoxidation products in the solid steel and tendency to pipe formation, but no difference could be found in mechanical properties and deep drawability between killed and not-killed soft steel. It is concluded that for many purposes, soft steel without additional deoxidizers is superior from several angles. A table gives test results for tensile strength, elastic limit, elongation, reduction of area and deep-drawability for steels deoxidized with the above named deoxidizers. 22 references. Ha (3b)

Reaction Between Oxides and Carbon Dissolved in Liquid Iron (Die Reaktion des im flüssigen Eisen gelösten Kohlenstoffes mit Oxyden) FRIEDRICH KÖRBER & WILLY OELSEN. *Die Naturwissenschaften*, Vol. 23, June 28, 1935, pages 462-465. The nature of the reactions occurring between C in liquid steel and oxides present in slags is characterized. It is pointed out, that the kinetics of the decarburization reaction does not represent a problem of chemical kinetics but that it is highly dependent on external conditions, viz. principally on those factors responsible for the formation of C-oxide bubbles in the steel bath. It was established that phenomena whose nature resembles delay in boiling have a bearing on the liberation of CO_2. The formation of the first gas bubble very rarely takes place spontaneously in the steel melt or at the steel/slag interface, but almost exclusively at those spots where the steel melt directly touches the solid crucible wall. EF (3b)

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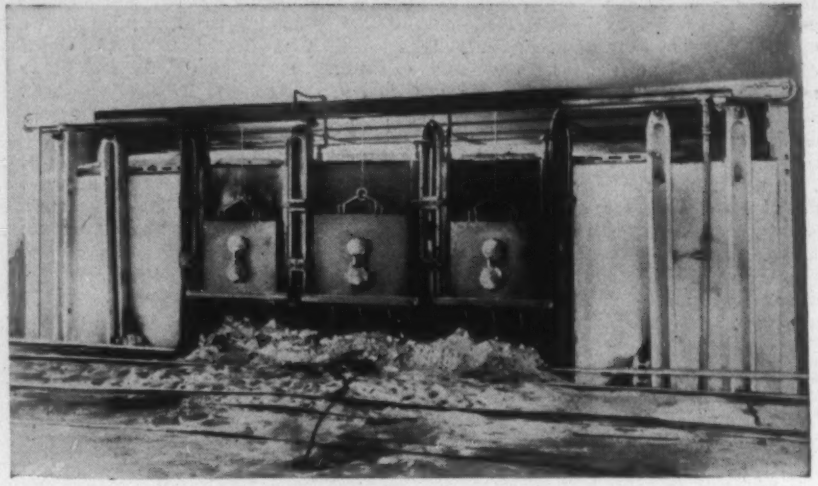

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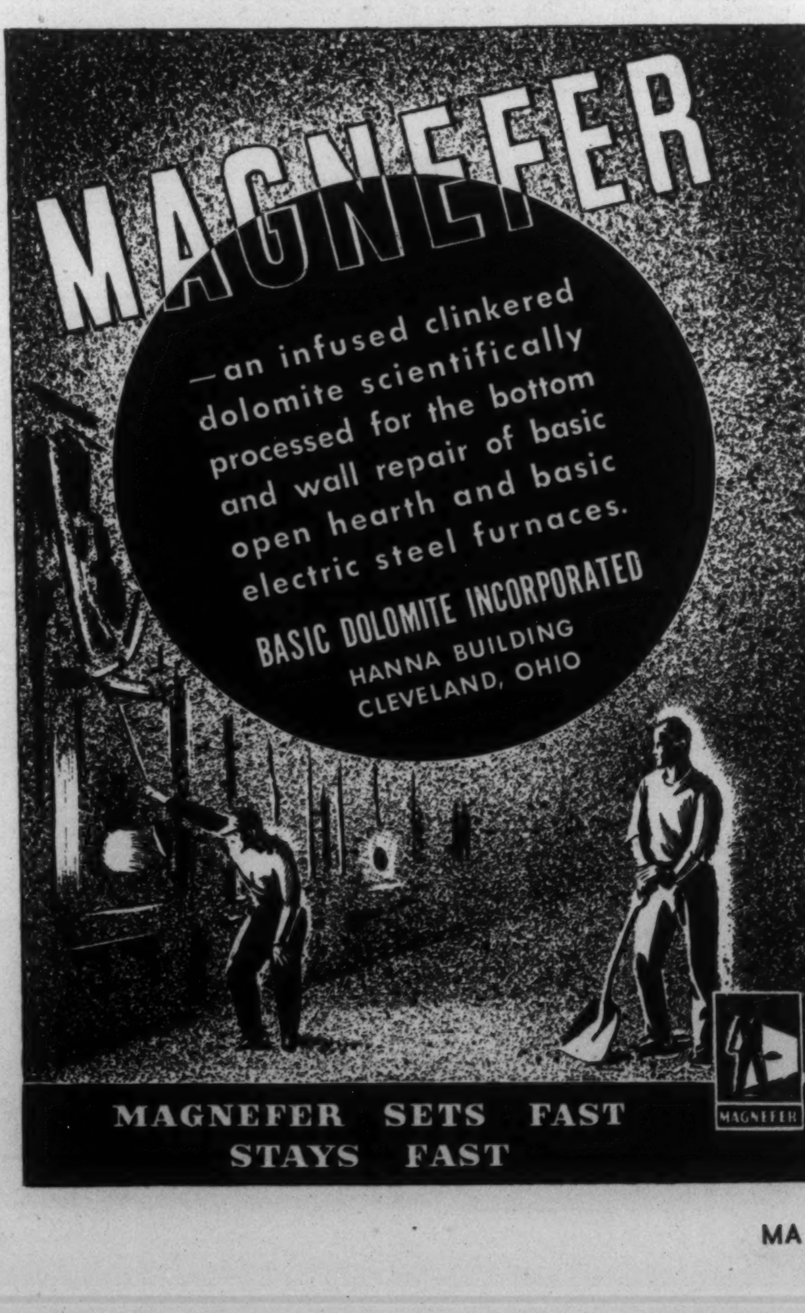

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Porosity, Reducibility and Size Preparation of Iron Ores. T. L. Joseph. *Metals Technology*, Feb. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 688, 19 pages. The efficiency of a blast furnace increases as the CO_2 in the top gas increases. The CO_2 can be increased by judicious crushing of the ore in order to permit more complete reduction in the upper shaft of the furnace. The most useful size of ore will depend on the reducibility of the ore. Relative reducibility of samples of hematite and limonite ore was determined by heating the ore in H and measuring the rate of formation of H_2O. Before determining reducibility samples were heated to 450° C. in order to dehydrate them to the same extent as in the blast furnace before reduction begins. True density of the materials was determined by the pycnometer and apparent density calculated from the weight of a sample and the volume of Hg that it displaced. Porosity was calculated from these two densities. The time required for 90% reduction was used as a measure of the reducibility. This was found to be directly proportional to the reciprocal of the porosity. From this relationship and the known optimum size for some ores of known porosity the optimum size for any ore may be calculated if its porosity is known. Porosity can be determined on either 10-gram or 50-lb. samples of ore. The maximum size of ore for blast furnace use is directly proportional to the porosity and is 0.75" for zero porosity and 3.5" for a porosity of 50%. 17 references. JLG (3b)

Reaction Course of the Basic Open Hearth Process (Über den Reaktionsverlauf beim basischen Siemens Martin-Verfahren) P. Bardenheuer & G. Thanheiser. *Die Naturwissenschaften*, Vol. 23, June 28, 1935, pages 460-462. The most important reaction in the basic open hearth process is the reaction between O and C. At higher C contents and reasonably high temperatures, the reaction rate is rather large. As long as C is present in the steel in sufficiently large quantities, the C content determines the O content of the bath. The more C is eliminated below a certain value, the more influence the ferrous oxide of the slag exerts on the O content of the steel bath. A fargoing reduction of the O content through the agency of C is (among other factors) of great significance with respect to the Mn reduction out of the slag. The more the Mn-content of the slag is made available the less the necessity for supplementary deoxidation. Thus the disadvantages connected with the introduction of ferro-manganese into the finished steel can be avoided. EF (3b)

Discussion of Paper on "Steel Castings" by C. W. Briggs. P. E. McKinney. *Journal American Society of Naval Engineers*, Vol. 47, Nov. 1935, pages 538-542. Experience of foundryman is stressed as being more valuable at times than design in producing soundness in casting. Radiographic inspection for high steam pressure castings is insufficient in that porous areas can be fully tested only by machining and pressure tests. Suggestion is made that prospective bidders on government specification castings investigate methods of inspection and finishing castings in Navy building yards. General approval is given C. W. Briggs' suggestion of government list for developing reliable sources of supply for its castings. WB (3b)

Production of High-Grade Castings for Machine Tools. D. M. Gurney. *Steel*, Vol. 97, Sept. 9, 1935, pages 32-35. **The Buyer's Views on Foundry Problems.** *Foundry*, Vol. 63, Oct. 1935, pages 34-35, 75-76. Describes practice of Sterling Foundry Co., Wellington, O., in making castings of high quality and accuracy for machine-tools such as lathes. Thorough training of efficient personnel, use of high-grade equipment and materials, and close control of all operations help to achieve the desired results. Required characteristics of lathe-beds are obtained by use of a high-test 1.5% Ni cast-Fe, cast in what is in effect a core mold. As much as 80% steel rails replaces pig-Fe in the cupola charge. MS + VSP (3b)

Ni-Hard. *Foundry Trade Journal*, Vol. 53, Nov. 28, 1935, pages 395-397. Communicated by the Bureau of Information of Nickel. The manufacture of "Ni-Hard" is protected by British Patent No. 279414. In the cast irons there are 2 distinct methods available for achieving hardness, one increasing the proportion of combined C by control of composition or by chilling and the other hardening the matrix of the metal by heat-treatment or alloying. A combination of the 2 abovementioned methods has been developed. In this the massive carbides are maintained, and, by suitable alloying, the matrix of the Fe is hardened. The use of sufficient alloys to ensure air-hardening, and therefore to obtain the desired result in the "as-cast" condition, offers an interesting and novel solution to the problem of increasing the hardness in white or chilled castings. The hardness of the carbides in a white Fe is generally given as about 700 Brinell, whilst that of the pearlitic matrix is generally of the order of 200 to 300. In "Ni-Hard" with an addition of about 4.5% Ni and 1.5% Cr the matrix hardness is increased to between 500 and 700 Brinell so that the hardness of chilled face is itself increased to 700 or 800. At the same time, the alloys refine and toughen both the chilled portion and the gray backing. Effect of Mn, spread of mottle, composition, microstructure and properties of "Ni-Hard," etc. are discussed. AIK (3b)

The Elimination of Physical Defects in Deep Drawing Steels. T. G. Grey-Davies. *Sheet Metal Industries*, Vol. 9, Sept. 1935, pages 548-549. Control of the teeming rate is pointed out as being an aid in the production of good sheet. Big end up molds lessen the trouble from "bleeding" of ingots. The need for careful reheating is pointed out. AWM (3b)

Huge Steel Castings Support Golden Gate Bridge Cables. *Iron Age*, Vol. 136, Oct. 3, 1935, pages 29-30. Describes the steel castings used to support cables on towers of Golden Gate bridge. Castings were made by Bethlehem Steel Co. and finish-machined by Midvale Co. Two open-hearth furnaces provided steel for the castings. Plain C steel was teemed into ladles, from which it was poured into pit molds, arranged for bottom pouring, with 9 risers per segment. After removal of risers, segments were annealed to remove internal stresses and machined. VSP (3b)

Heterogeneity of Steel Ingots. Sixth Report to the (British) Iron and Steel Industrial Research Council. *Iron & Coal Trades Review*, Vol. 121, Sept. 20, 1935, pages 421-423; *Engineer*, Vol. 160, Sept. 27, 1935, pages 324-325; *Engineering*, Vol. 140, Sept. 20, 1935, pages 304-305; Sept. 27, 1935, pages 341-342. See *Metals & Alloys*, Vol. 7, Jan. 1936, page MA 4L/2. Ha + LFM (3b)

Some Trends in Steel Metallurgy During 1935. J. H. G. Monypenny. *Metallurgia*, Vol. 13, Dec. 1935, pages 50-52. Mentions new and cheap alloy steels of the automotive type. Discusses the significance of grain-size control and points out that a particular grain size is frequently specified when the buyer has no idea what is meant by the grain size specified. Al is added to make fine-grained steels and such steels may contain many invisible inclusions. The buyer is apt to specify steels free from non-metallics—those that he can not see in the microscope—and also fine grain. Too often electric steel is specified when acid-open-hearth steel would be just as good or even better. Highly polished corrosion-resistant sheets are now being produced. JLG (3b)

Finishing the Heat of Steel. XXXVII, XXXVIII. J. H. Hruska. *Blast Furnace & Steel Plant*, Vol. 23, Nov. 1935, pages 769-770; Dec. 1935, pages 852-853. Deals with hot tops for ingots. Volume of steel in hot top ranges from 12 to 28% depending on type of steel. Details of design are discussed. New C & D hot top is described in detail. Ingot corner construction and mold wall thickness are tabulated for various types of ingots. Ingot molds of varying wall thickness are more subject to longitudinal cracking than those with identical thickness. MS (3b)

The Cupola and Good Quality Castings. Walter West. *Metallurgia*, Vol. 13, Jan. 1936, pages 83-84. Gives precautions to observe in the production of high-strength Fe castings from cupola Fe. JLG (3b)

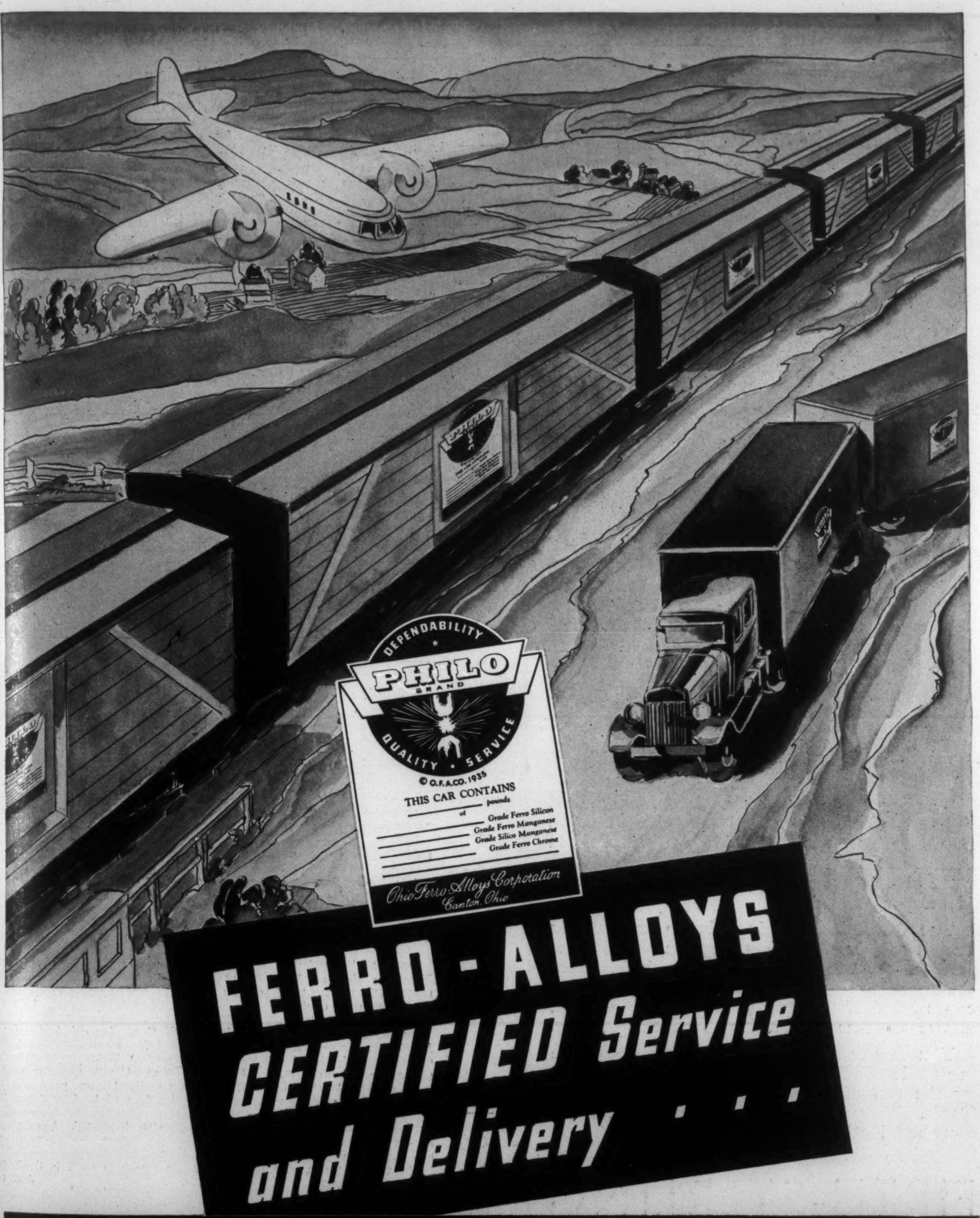
Finishing the Heat of Steel. Pt. XXXIX. J. H. Hruska. *Blast Furnace & Steel Plant*, Vol. 24, Jan. 1936, pages 68-70. Largest percentage of molten steel is poured into 1-piece molds. Advantages are absence of any particular set-up and production of more desirable bottom portion of ingot. Disadvantages are higher costs, slightly more difficult stripping, and scrapping of otherwise good molds due to premature bottom failure. Split molds are used to a large extent in alloy and tool-steel manufacture. Dividing plane is generally diagonal for molds of square or rectangular sections, but molds divided into a plane perpendicular to 2 parallel faces give equally good service. Parts should be in exact alinement and joint should be very close and as heavy as possible. Relatively shorter life of split molds is due principally to defective joints, but they are easy to clean, coat, and inspect, and there is absence of ingot stickers. Weight of ingots made in split molds ranges from 20 to 3500 lb. Composite molds constitute most of the molds used in quality mills. To keep down inventory of molds used for heavy forging ingots, 1 mill uses a standard octagon mold of big-end-up type and places suitable inserts between mold and hot top for larger ingots. A somewhat different hot top is applied for the various sizes. In Europe, bottom plugs are used in manufacture of inverted ingots of the slab, split, polygonal, or round types. Size of plug should vary with weight of ingot. Refractory brick plugs are coming into more general use. MS (3b)

Steelmaking in 1935. Emil Gathmann. *Blast Furnace & Steel Plant*, Vol. 24, Jan. 1936, pages 91, 99. Quality of steels is improved by melting and keeping them molten at a high temperature. They should, however, be teemed as cold as practical. A 100-ton heat can be held in the ladle as much as 15 min. without causing difficulties. Ladles should not be too deep compared to width. Elliptical ladles that are relatively shallow are very efficient. There are fewer defects when steel is teemed from ladle on the cold side through relatively large nozzles. Tendency to crack and contain axial porosity is greater the larger the cross-section of the ingot and the more nearly circular its section. Use of gas-forming mold washes enhances tendency to crack. MS (3b)

The Control of Cupola Operation. H. L. Campbell & John Grennan. *Iron Age*, Vol. 136, Dec. 19, 1935, pages 18-23, 84, 86. Discusses the combustion conditions within the cupola and the proportioning of the metal, flux and air supply. Combustion condition within cupola can be established by analysis of cupola gases. With good cupola practice proportions by vol. of CO_2 and CO in gases just below charging door will be equal. Fe of good quality will be produced if coke bed is sufficiently high so that all melting of metal charges will be confined to that portion of cupola in which there is no free O_2. Coke consumed is replenished by the intermediate coke charges. In this way, coke bed is maintained at proper level to insure favorable melting. Ratio of metal melted for each lb. of coke is dependent on quality of coke, relative proportion of surfaces of pieces of metal exposed to hot gases, and amount of superheat required in metal. Most satisfactory fluxing material is CaO. Gives number of tables showing air required for different air conditions, metal to coke ratios, air supply and melting rate, etc. VSP (3b)

Suggestions for Research on Steel Castings. J. H. Andrew. *Engineer*, Vol. 160, July 19, 1935, page 73; *Engineering*, Vol. 140, Oct. 11, 1935, pages 405-406. From a paper read before the Institute of British Foundrymen, July 4, 1935. See *Metals & Alloys*, Vol. 7, Feb. 1936, page MA 56R/7. LFM (3b)

Preparation of Cerium Iron (Die Herstellung des Cereisens). Heinz Foelsch. *Chemiker-Zeitung*, Vol. 59, Dec. 21, 1935, pages 1036-1038. Alloys of Ce and Fe are pyrophoric. The commercial alloys usually contain 72-78% Ce, 17-28% Fe, 0-4.5% Zn, 0-2% Mg, 1-2% Si and small amounts of other metals. A Ce rich alloy is first made, containing about 93.5% Ce, 4.5% Fe, .5% Al, .3% Ca and .5% Si. It must be free of slag and oxides and low in C. If the Ce is impure it should be refined before alloying by melting in a graphite crucible under NaCl or KCl. The alloying can be done in a clay crucible heated by any suitable means which prevents the access of combustion gases. The crucible is preheated, the Ce melted first and Fe in small pieces added, then the other metals with stirring. The temperature is kept at 1050°-1150° C. The Fe melts readily in the molten Ce. If Zn is added it raises the temperature. The metal is kept covered with NaCl, KCl or $BaCl_2$. It takes about 1 hour to make a heat. Ce-Fe alloys cannot be rolled. They are cast into molds which consist of a large number of thin steel tubes, insulated from each other with sand. The molds are preheated to 800°-900° and placed on top of a cooler to keep the bottom cool. After pouring off the salt and slag the melt is cast quickly and the top of the molds covered with $BaCl_2$ to prevent oxidation. The rate of cooling is very important to obtain good pyrophoric properties. Sand is placed around the mold and when it becomes hot it is replaced with cold sand. After about 2 hours the sand is removed and the molds allowed to cool 1 to 2 hours more and then opened. The sticks are pickled in 1 to 2% HCl, cut to length and kept under oil to prevent oxidation. CEM (3b)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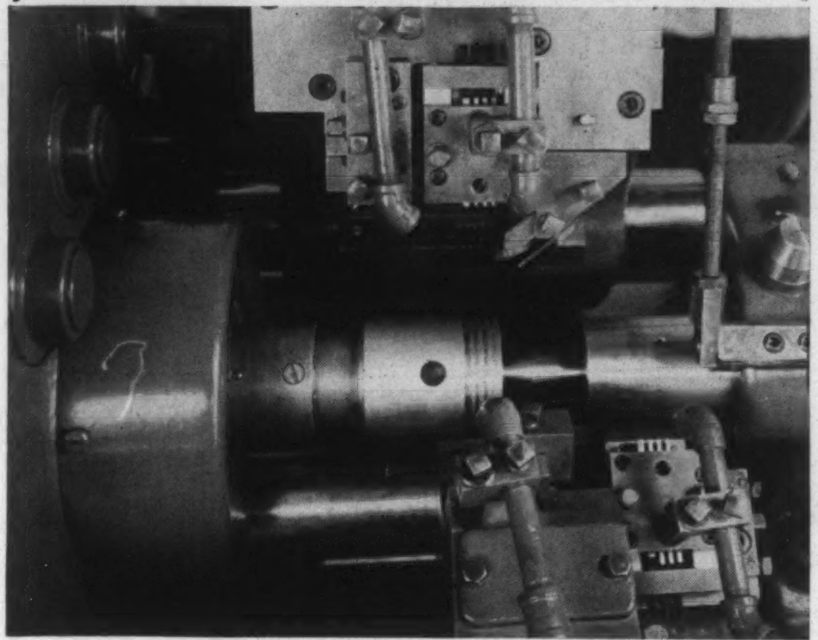

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4. WORKING

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

New Carnegie-Illinois McDonald Strip Mill. *Iron Age,* Vol. 136, Dec. 19, 1935, pages 28-30. Describes a 43″ continuous strip mill completed at McDonald, Ohio. The mill will produce strips up to 37″ wide and ranging in thickness from no. 18 gage to ⅜″. It has a capacity of 30,000 tons a month. VSP (4a)

New Classifier Minimizes Gage Variations in Flat-Rolled Steel. *Iron Age,* Vol. 136, Oct. 3, 1935, pages 26-28. Describes a classifier patented by Jones & Laughlin Steel Corp'n. This unit will separate sheets produced from cold rolled strip into several different classifications and can hold tolerances from standard gage within small limits. It is manufactured by Aetna-Standard Engineering Co. Illustrates a typical installation. VSP (4a)

High-Speed Fly-Wheel for Rolling Mill. *Engineer,* Vol. 160, Dec. 20, 1935, pages 654-655. The wheel is designed by Hick, Hargreaves and Company, Limited of Bolton, England. The wheel takes the peak load as the ingot enters the mill and at the end of the pass it speeds up in readiness for the next ingot. The load on the motor remains fairly steady and may be as little as 1/5 of the peak load of the equipment. LFM (4a)

Steel Tubes (Le tube d'Acier) *Chaleur et Industrie,* Vol. 16, Nov. 1935, pages 525-526. General article. Various methods for manufacturing tubes are reviewed. FR (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Buick Improves Quality and Cuts Costs of Forgings. ROBERT H. CARNTON. *Iron Age,* Vol. 136, Oct. 3, 1935, pages 18-21, 90. Deals with the improvement in quality and lower costs of crankshafts and transmission gears obtained by Buick Motor Car Co. by installation of new forging equipment and change in forging practice. Some details of the steam drop hammers, dies, etc. (including analyses) are recorded. Round cornered square billets of General Motors No. 1045 steel are used for the crankshafts forgings which are subsequently heat treated in a continuous pusher type oil fired furnace. All transmission gears are pierced instead of being produced as a solid blank and General Motors No. 3150 steel is used. VSP (4b)

4c. Cold Working, including Shearing, Punching, Drawing & Stamping

Metallurgical Aspect of Cold Pressing and Drawing. C. H. DESCH. *Sheet Metal Industries,* Vol. 9, Apr. 1935, pages 195-196. Discussion included. A general discussion pointing out the fact that improvement in sheet will result only from a careful control of all stages in its production. AWM (4c)

New Researches on the Drawing of Cylindrical Shells. G. SACHS. *Sheet Metal Industries,* Vol. 9, Apr. 1935, pages 196-197, 223. Discussion included. It is pointed out that drawing capacity depends to a great extent upon the form of the tool and on the form imparted to the blankholder. The calculation of the stresses and strains in deep drawing is given consideration. AWM (4c)

Experimental Manufacture of Copper-Beryllium Wire. I. YA BERKOVSKY. *Tzvetnuie Metallui,* Apr. 1935, pages 115-121. In Russian. Describes experiments in the manufacture of beryllium bronze wire and its heat treatment and the physical properties obtained. BND (4c)

Locomotive Wheels, Tyres and Axles. E. S. COX. *Journal Institution of Locomotive Engineers,* Vol. 25, Nov.-Dec. 1935, pages 761-828. Includes discussions in London, Birmingham, and Manchester. Design, manufacture, and maintenance of wheels, tires, and axles are discussed, with particular reference to practice of L.M.S. railway. To prevent corrosion between wheel and tire, the interposition of a Cu ring, 1/20″ thick, has been tried. After 3 yrs. there has been no sign of spreading. Correct shrinkage allowances are important; the L.M.S. standard is 1/1200 of the wheel diameter + 0.005″. When pressing axles on wheel centers, the nature of the lubricant used to prevent tearing may have very great effect on the pressure required. The combination of a parallel hole in the wheel and a taper of 1:500 on the axle appears to result in the best fit over the whole length. JCC (4c)

4d. Machining

H. W. GRAHAM, SECTION EDITOR

A Study of the Turning of Steel Employing a New Type Three-Component Dynamometer. O. W. BOSTON & C. E. KRAUS. *Transactions A.S.M.E.,* Vol. 58, Jan. 1936, pages 47-53. The instrument measures the cutting force as a function of the elasticity of its steel members. The magnitude of the radial, longitudinal and tangential components varies widely for different metals, with feed and depth of cut and tool shape. Test results are given in full. Ha (4d)

5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Thermal Treatment of Alloy Tool Steels. RICHARD SAXTON. *Heat Treating & Forging,* Vol. 21, Nov. 1935, pages 515-516, 521. Outlines principles underlying efficient heat treatment of alloy tool-steels. Stresses importance of allowing sufficient time for raising to desired temperatures. Adequate time for soaking is also essential in all processes of applying heat to tool-steels other than high-speed. There should be as little delay as possible in tempering steels after hardening. Grinding should not be done on steels in hardened or tempered condition.
MS (5)

Aluminium Alloy Heat Treatment. *Journal of Commerce, Shipbuilding & Engineering Edition,* Nov. 21, 1935, page 5. A discussion of the composition and processes of manufacture of the principal high strength alloys now in use with special reference to their high-temperatue or solution-treatment, quenching, and subsequent age-hardening. The alloys dealt with are the Y alloy and the R.R. alloys, 50, 53 and 53B.
JWD (5)

Modern Heat Treatment. H. TOPLIS. *Journal Institution of Production Engineers,* Vol. 14, Nov. 1935, pages 591-593. Further discussion on this paper. For abstract of original paper see *Metals & Alloys,* Vol. 5, Aug. 1934, page MA 392.
JCC (5)

■ 5b. Hardening, Quenching & Drawing ■

The Heat Treatment of Super-High Speed Steels. J. C. ALEXANDER. *Mechanical World & Engineering Record,* Vol. 48, Dec. 13, 1935, pages 569-570. Heat treatment and microstructures of high speed steels. No analyses given.
WH (5b)

Develops Oxyacetylene Flame Hardening Machine for Large Bevel Gears. *Steel,* Vol. 98, Feb. 10, 1936, pages 42, 44. Describes universal machine developed by Gleason Works, Rochester, N. Y. It will accommodate pitches from 5 diametral pitch and diam. up to 100". No measurable distortion has been found in surface hardened gears. Machine hardens both sides of a tooth simultaneously. Quenching is done by 2 small H_2O streams directly back of burners. Operation, other than indexing, is entirely mechanical. Steel recommended for surface hardening is a casting or forging containing 1.25% Mn and 0.35% C, or S. A. E. 6145. Wearing surface equal to case hardening can be obtained.
MS (5b)

■ 5e. Carburizing ■

Abnormal Structure in Carburized Steel. HIROSHI SAWAMURA & AKIRA IMANISHI. *Suiyokwai-Shi,* Vol. 8, Dec. 1935, pages 923-928. Armco Fe was carburized at 950° C. with liquid hydrocarbons such as benzene, toluene, pentane, hexane, heptane and octane, using CO as the vehicle to introduce these liquid hydrocarbons into the carburizing tube. It was confirmed, from the experiments, that these hydrocarbons are generally very effective for preventing the formation of the abnormal structure in the carburized case of Armco Fe. Commercial low C steels were also carburized with acetylene, benzene and pentane. Abnormal structures are, however, developed in these cases even though the O_2 contents of these steels were almost the same as that of Armco Fe or less.
HN (5e)

■ 5f. Nitriding ■

Hardening of Steel by the Nitrogen Process. H. W. BOWEN. *Journal & Record of Transactions Junior Institution of Engineers,* Vol. 45, Aug. 1935, pages 474-493. Lecture delivered before the Institution at Manchester reviews the subject from the point of view of the mechanical or production engineer, rather than from the metallurgist's viewpoint. The 3 grades of nitralloy steel widely used in Great Britain contain .35% Si, .65% Mn, .25% Ni, 1.4-1.8% Cr, .9-1.3% Al and (1) .35-.45% C, (2) .26-.35% C, (3) .20-.26% C. The physical properties are tabulated. A comparison between carburizing and nitriding is made. Nitriding equipment, hardness distribution curves in case, microstructures, nitriding growths, distortion, physical properties, application, decarburization and welding of nitralloy steel are dealt with.
WH (5f)

Heat of Formation and Free Energy of Formation of Boron Nitride. SHUNICHI-SATOH. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 14, Dec. 1935, pages 1233-1240. In Japanese. *Scientific Papers & Abstracts Institute of Physical & Chemical Research, Tokyo,* Vol. 28, Dec. 1935, page 72. In English. The heat of formation and the free energy of formation of boron nitride and the specific heats of B, N and B-nitride are $2\ BN = 2\ B + N_2 - 56{,}940;\ \Delta\ F^\circ = 54{,}760$.
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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

The Crystal Modifications of Zirconia. W. M. Cohn. *Paper, Electrochemical Society,* Oct. 1935, pages 333-339. Author's abstract: "—It was found that ZrO_2 can be prepared in 3 distinct modifications with widely different expansion coefficients, a monoclinic, a tetragonal and a trigonal one. The monoclinic modification is stable between room temperature and 1000° C. On the basis of these observations it was possible to regulate the temperatures in the manufacture of zirconia refractories so as to eliminate cracking and disintegration. Clear, fused zirconia was prepared in the sun furnace at temperatures exceeding 2700° C. This furnace focuses the sun's energy onto a small holder through which a compressed rod of ZrO_2 is slowly passed. Clear fused zirconia has a yellowish tint, is harder than silicon carbide, and very resistant to acids and slags." GBH (6)

Solution of the Problem of Hot Stoves (Resolution integrale du problème du Cowper) Maurice Derclaye. *Revue de Métallurgie,* Vol. 32, Oct. 1935, pages 427-430. A very complete mathematical analysis of the phenomena taking place in blast furnace hot stoves. From the theoretical standpoint double zone stoves have a better temperature drop. This factor can be improved in single zone stoves by increasing the optimum minimum thickness of the checker work. A parallel study of single zone and double zone stoves shows mathematically that the effects are the same. Single zone is, however, less complicated mechanically. The use of heavy checkers in the upper part of the stoves to increase their mechanical strength and their resistance to temperature changes is sound, but since the manufacturers of fire bricks learned how to make high resistance multiple hole checker bricks, the results obtained with them in single zone stoves are at least equal to those of the double zone stoves. The efficiency of stoves can be raised from 88.3% to 92% by building around the usual shell another shell, and passing the air to be heated between them. The frequency of reversals has a preponderant influence. Doubling it, for example, would correspond from the standpoint of thermal efficiency to doubling the conductivity of the bricks and their thickness. JDG (6)

Electric Heat in a Factory. W. Easton. *Electrical Review,* Vol. 118, Jan. 24, 1936, pages 117-118. Describes applications of electricity for various heating operations in connection with manufacture of radio apparatus at Moston factory of Messrs. Ferranti, Ltd. Includes soldering-irons, spot welders, and furnaces for degasifying vacuum-tube grids and anodes, annealing punchings, and hardening high-speed steel tools. MS (6)

Bright Annealing Furnace. H. M. Heyn. *Heat Treating & Forging,* Vol. 21, Nov. 1935, pages 542-543. **Controlled-atmosphere Furnace for Bright Annealing Copper Tubing.** *Steel,* Vol. 97, Nov. 18, 1935, pages 44, 46. See *Metals & Alloys,* Vol. 6, May 1935, page MA 189R/2. MS (6)

A New Ingot Heating Furnace. *Iron Age,* Vol. 136, Nov. 21, 1935, pages 34-35. Describes furnace developed by Salem Engineering Co. Hole is circular in section, with charging opening 11 ft. in diam. and 7 ft. deep. Pit is fired by gas of about 500 B.T.U./ft.^{3} thermal value. Proper mixture of gas and air, and temperature of furnace are automatically controlled. Gives advantages of this type of furnace. VSP (6)

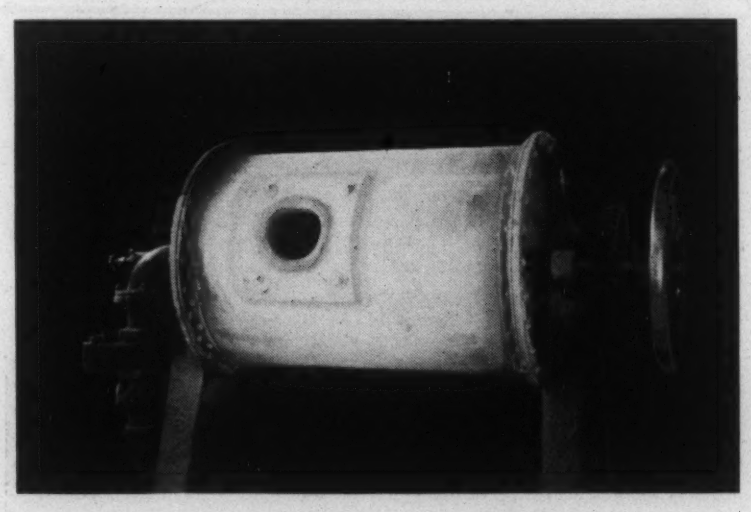
Furnace Design and Operation. *Heat Treating & Forging,* Vol. 21, Dec. 1935, pages 589-592. Discusses principles, advantages, operation and design of the Stevens open-hearth furnace, and gives results obtained in practice. MS (6)

High-Frequency Induction Furnace Steel Plant. *Engineering,* Vol. 140, Nov. 8, 1935, pages 513-514; *Electrical Review,* Vol. 118, Jan. 24, 1936, page 128. Describes furnaces recently installed at the Wicker Works, Sheffield, of Messrs. Samuel Osborn and Company, Limited. There are 2 high-frequency electric induction-furnace steel-melting plants. There are 4 furnaces in all, 2 of ½ ton capacity and 2 of ¼ ton capacity, each with its own tilting gear. The equipment is used in producing special heat- and corrosion-resisting steels and alloy steels such as Ni-Cr air-hardening and oil-hardening steels, Ni steels and Cr-V steels. MS + LFM (6)

Testing Metallurgical Fuel Oils. John H. Hruska. *Iron Age,* Vol. 136, Oct. 24, 1935, pages 20-23, 92. Author contends that an accurate check on the viscosity of fuel oil is more valuable than sp. gr., since gravity determinations give an inaccurate check of the suitability of oils for metallurgical purposes. Describes the Steiner test which is shown to be quicker and simpler in operation and also more accurate than the Saybolt viscosity test. Complete temperature viscosity curve may be obtained quickly even by unskilled worker. Includes table giving technological properties of fuel oils used in iron and steel industry. VSP (6)

Progress in Design and Application of Electric Furnaces. H. Knight. *Metallurgia,* Vol. 13, Dec. 1935, pages 53-56. Describes melting and heat-treating furnaces recently installed in England. JLG (6)

Metallization of Electric Furnace Electrodes. G. F. Morenko. *Domez,* No. 8, 1935, pages 39-45. In Russian. Plant experiments conducted on 5 ton arc furnaces using 225 mm. electrodes coated with Cu and with Al by Schoop process showed that the Al coating did not offer any protection and Cu coating reduced the average electrode consumption from 12.05 kg./ton to 10.67 kg./ton. The figures were obtained as the result of 3 heats in which one of the electrodes was coated, two others being plain carbon electrodes. Al does not protect because it oxidizes too soon and forms an inadhesive oxide. (6)



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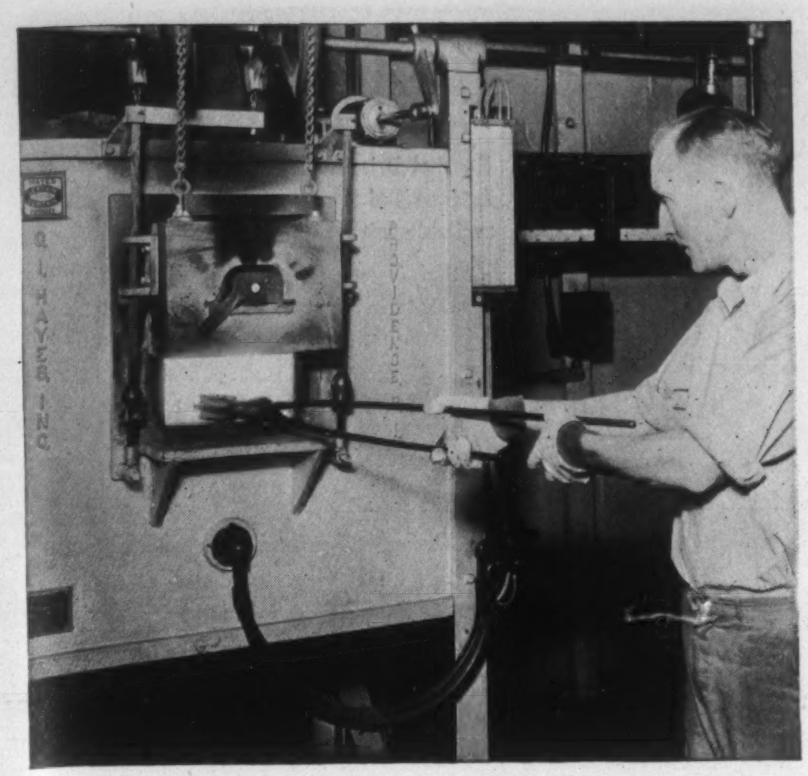

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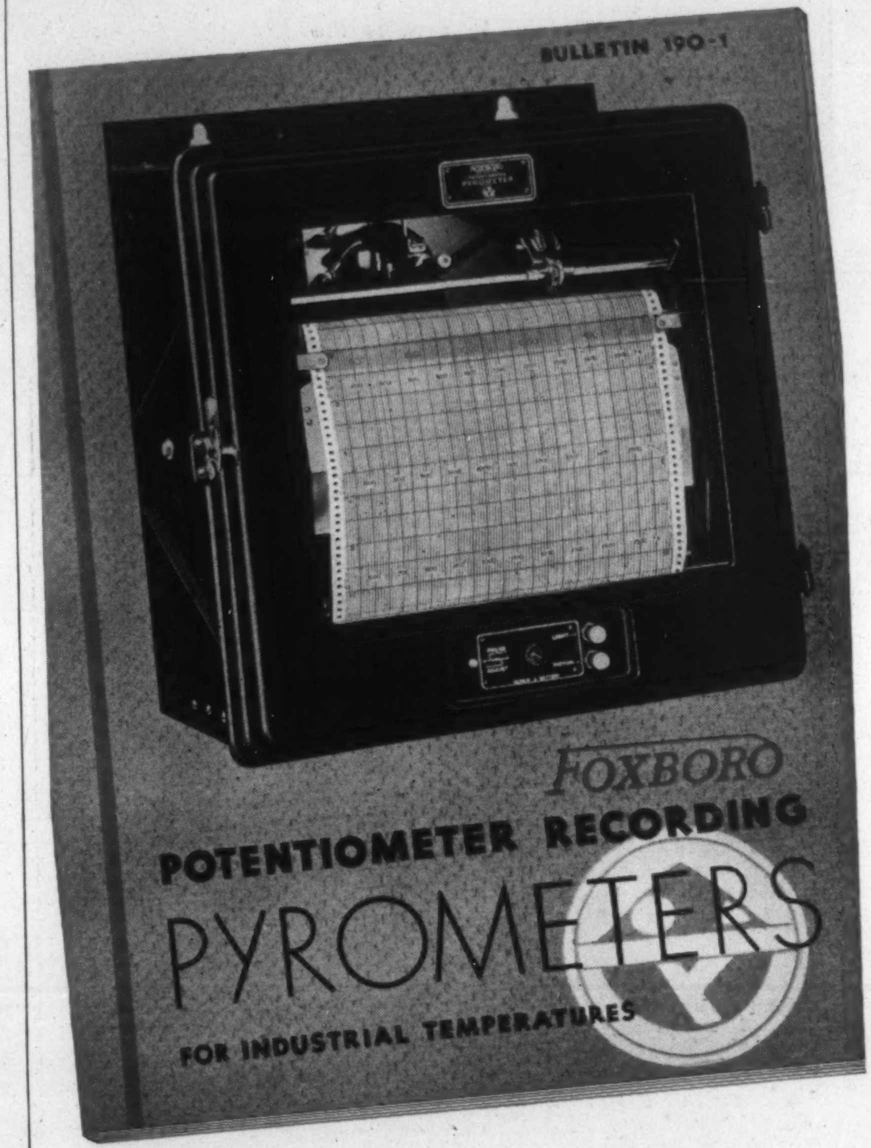

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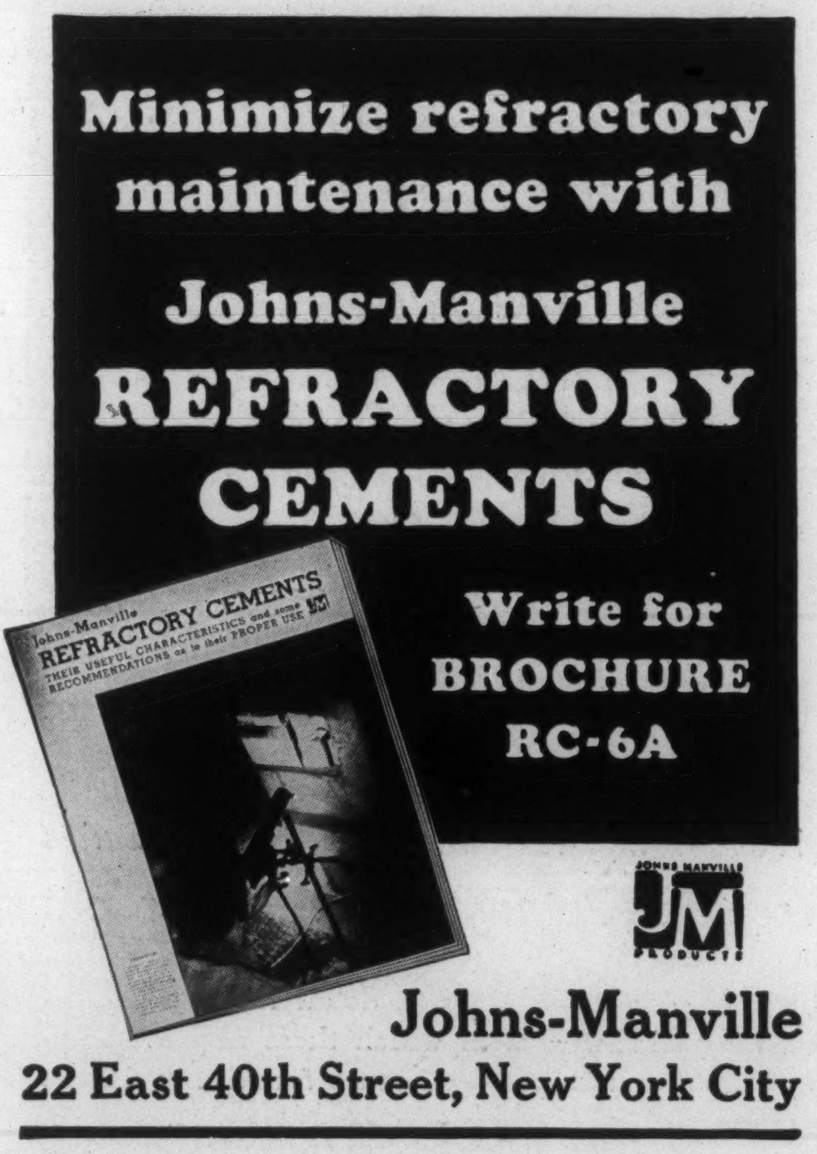
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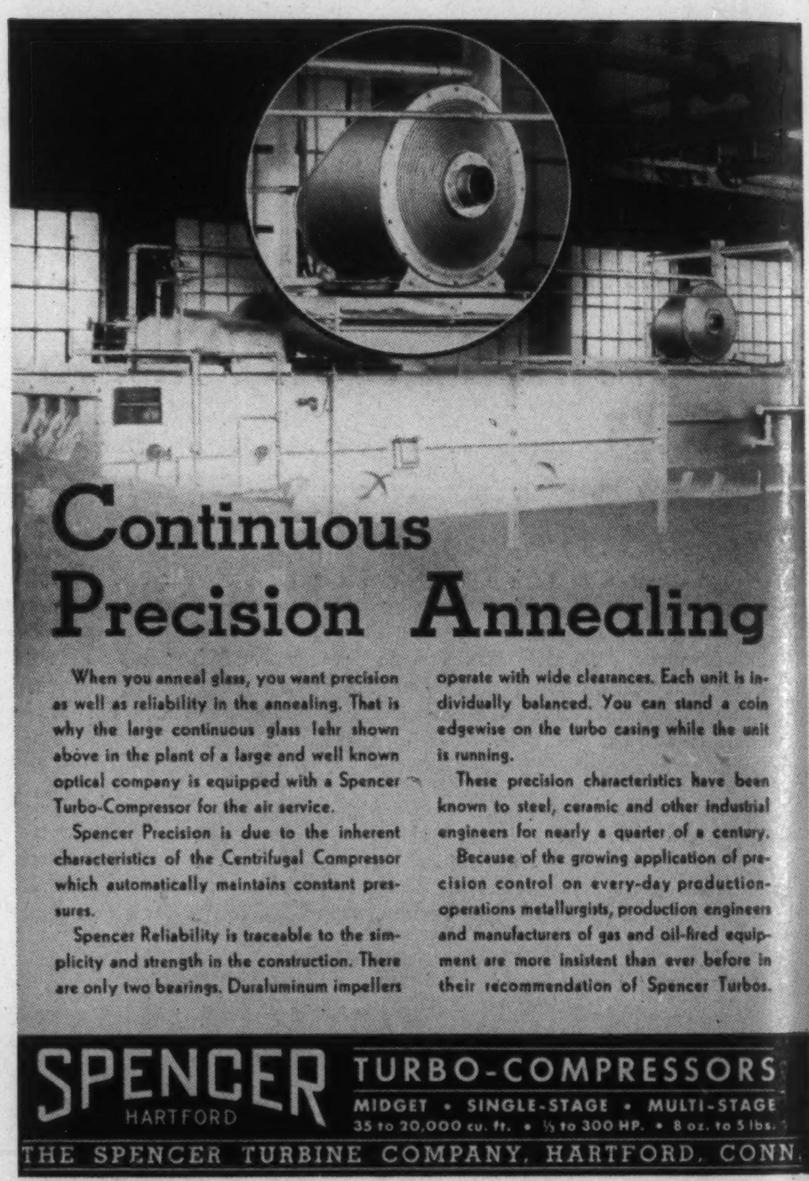
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Six-Station Vertical Turret Machine Used in Case Hardening Staybolts. *Steel,* Vol. 98, Jan. 27, 1936, pages 49-50. Flannery Bolt Co., Bridgeville, Pa., employs a specially-constructed machine to case-harden heads of flexible forged steel staybolts on a continuous basis. It is provided with 6 arms, each having a bolt chucking mechanism suspended at the end. Each chucking mechanism can accommodate 45 bolts. The 6 stations of turret are loading, preheating, final heating, quenching, washing, and unloading. Machine is entirely automatic in its operation. MS (6)

Refractories Meeting New Demands. *Steel,* Vol. 98, Jan. 6, 1936, pages 237, 335-336. Review of progress in the refractories industry in 1935 as seen by various authorities. MS (6)

Top-Charge Melting Unit Handles Bulky Scrap. *Steel,* Vol. 98, Jan. 13, 1936, pages 41, 72. Describes top-charge electric furnace developed by the Pittsburgh Lectromelt Furnace Corp. Roof operates in a horizontal plane instead of tilting. Lifting and swinging aside of roof is done by a powerful ram from a stationary cylinder separate from furnace shell. Results with this furnace in actual operation show lower power cost, 30% less refractories cost, and 14-35% lower electrode consumption, compared with fixed-roof furnaces. MS (6)

Gas Furnaces for Forging Plants. *Machinery,* N. Y., Vol. 42, Jan. 1936, pages 332-333. A furnace for a scheduled performance with controlled atmosphere to reduce decarburization of the surface of the forgings is described. Ha (6)

Investigation of an Electrically Heated Enameling Furnace (Untersuchung an einem elektrisch beheizten Blech-Emaillierofen) H. MEYSENBURG. *Elektrizitätswirtschaft,* Vol. 34, Sept. 15, 1935, pages 576-581. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 13L/10. WH (6)

The Supply of Acetylene for Industries. A. MCMILLAN. *Iron & Steel of Canada,* Vol. 18, Dec. 1935, pages 91-94. The properties of the oxy-acetylene flame and its industrial uses are explained and the sources and manufacture of Ca carbide in Canada are described. Ha (6)

Malleable Furnace Refractories. L. C. HEWITT. *Foundry Trade Journal,* Vol. 53, Oct. 10, 1935, page 280. See "Notes on Refractories for Electric Furnaces Producing Special Irons," *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 13L/8. AIK (6)

Application of Electrical Heat in Ferrous and Non-Ferrous Industry with Particular Reference to the Saar District (Elektrowärmeanwendung in der Eisen- und Metallindustrie insbesondere im Saarland) W. RODENHAUSEN. *Elektrizitätswirtschaft,* Vol. 34, Oct. 25, 1935, pages 670-675. Paper before the Annual Meeting of the German Power Plant Associations, Sept. 1935, at Saarbrücken, gives data on the extent to which electric furnaces are in use in metal industry in the Saar Basin. The various furnace types are described. The picture of a 4 ton, 350 kw., 16 Hertz, cos $\Phi = 0.55$ vacuum furnace, type Rohn, as well as other German resistance, induction and arc furnaces are shown. WH (6)

7. JOINING

■ 7b. Welding & Cutting ■

E. V. DAVID, SECTION EDITOR

Welding as Applied to Shipbuilding. C. S. Lillicrap. *Welding Journal,* British, Vol 32, Nov. 1935, pages 329-331. Successful welding on large scale is considered to be a difficult matter and the literature on welding should contain a record of welding failures in order to advance the art by study of the unsuccessful cases. For thick plating the butt joint should be used while for thin plating the lap joint is the better at present. Bare wire welds should be restricted to joints with known small stresses and not subjected to shock or dynamic loading. Small diam. electrode and multiple passes are favored over larger electrode and single pass. Discussion brings out opinion that welded butt joints in shipbuilding have better fatigue resistance than riveted butt joint. WB (7b)

European Specifications for Heavy Welding. Federico Giolitti. *Metal Progress,* Vol. 28, Dec. 1935, page 54. Discusses European requirements for coefficient of load in weld to base metal load, electrodes and welder qualifications with some light on their evolution in various countries. WLC (7b)

Electric Arc Welding and Its Application. IV, V. M. le Brun. *Welding Journal,* British, Vol. 32, Sept. 1935, pages 277, 280; Oct. 1935, pages 294-297, 316. Discussion of electrodes, current consumption, rod coatings and structure. WB (7b)

Designers' Problems with Welded Steel in Machine Tools. Robert E. Kinkead. *Machine Design,* Vol. 7, Sept. 1935, pages 46-49. Typical illustrations of welded machine tool members are shown and problems involved in the adoption of welding in this engineering field are critically discussed. WH (7b)

The Welding of Copper-Nickel-Molybdenum Steel. Howard L. Miller. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, pages 28-30. Use of high tensile steel for fabrication of auto truck and tank bodies is discussed. Reduction of 30 to 50% in gage of sheets over former sheets of common steel used is cited as necessitating welding to use full strength of metal. Elimination of air hardening strengtheners Cr, Si, V makes possible ductile weld. Representative analysis of low C grade is .095 C, .70 Mn, .017 P, .028 S, .03 Si, 1.44 Cu, .75 Ni, .07 Mo, with yield of 69,800, tensile 82,400. elongation in 2" of 32%. A progressive survey of Rockwell B hardness across butt and lap welds shows only slight increase in hardness in heat affected zone over that of parent material and the hardness of the disturbed zone is of the same order as that of the weld itself. Drop tests on large tanks were made to show impact resistance and ductility of welded seams. Several truck and tank bodies fabricated by welding are shown in photos. WB (7b)

Progress in Welding Large Railway Bridges. O. Bondy. *Railway Gazette,* Vol. 63, Sept. 27, 1935, pages 492-497. The bridge carrying the German State Railway over the strait between Stralsund and the isle of Rügen is the largest plate girder bridge yet built by welding. It represents important advances in welding practice and in the testing of welds. As a first example of the innovations resulting from the progress in welding practice reference is made to new rolled sections for the flanges of welded plate girders. The dimensions of the novel "Nasenprofil" or bossed and grooved rolled sections are given. It is only necessary to insert the web in the grooves of the bossed flange plates and make 4 fillet welds. The new structural members are the outcome of prolonged experience in the fatigue testing of welded girders. The rounded form of the completed weld is a decisive technical advantage. The small thickness of the web compared with the flanges is another noticeable feature. A standard practice in Germany is that welds of railway bridges are inspected by X-rays using a working voltage up to 250,000 volts. A new "general exposure method" now enables a large area to be examined at once (52.5 ft. examination by a single exposure) and the requisite preparations can be completed in about 10 minutes. Magnetic clamps hold the wrapped films securely even on overhanging surfaces. About 25% saving in weight and about the same saving in cost were effected by the welded structures as compared with riveted ones. One of the latest methods of welding lengths of web plate in long span bridges is by means of the swallow-tail joint, which increases the weld, reduces the stress on the weld metal and avoids the use of straps covering the joints. WH (7b)

Resistance Process Applied to Welding Copper-Plated Steel Tubes. *Iron Age,* Vol. 136, Oct. 24, 1935, page 35. Describes 2 resistance welding machines for Cu-plated steel tubes of the Thomson-Gibbs Electric Welding Co. One machine is used to weld a double Cu-plated steel tube which is part of an automobile fuel feed system. Other machine is more unusual because welding transformer serves as a heating unit and does a faster job than was formerly done in electric furnace. Heating unit is linked with a forming machine which shapes tube from flat strip steel. As tube leaves forming machine it is pushed through heating unit where Cu coating is melted and steel fused into tight joint. VSP (7b)

Gas-Fusion Welding in the Repair Work of the German State Railways (Gasschmelzschweissung in Reichsbahn-Ausbesserungsbetrieben) A. Matting. *Autogene Metallbearbeitung,* Vol. 28, Dec. 15, 1935, pages 376-377. Applications of welding, cutting and surface treating are briefly discussed. Ha (7b)

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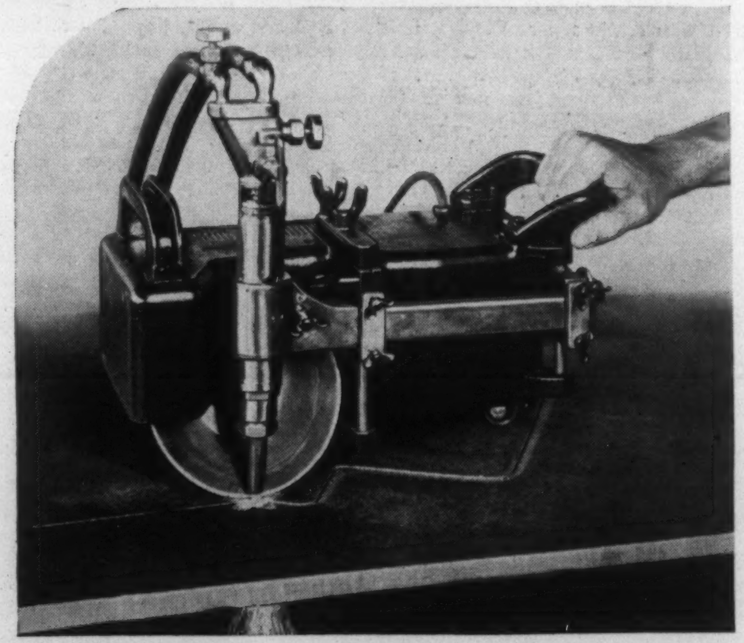

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Applications of Oxy-Acetylene Welding (Applications de la Soudure oxyacétilénique). Granjon. *Usine,* Vol. 44, Oct. 10, 1935, page 34. General review of oxy-acetylene welding and comparison with other methods. Except for Fe, welding of all metals including Al, Cu, bronze, nickel silver, is better done with oxy-acetylene than with any other method. Ha (7b)

The Organization of Welding in France. R. Granjon. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 223-225. Brief description of school of welding in France. Points out that oxy-acetylene welding has a large field. JLG (7b)

An Electrically-Welded Heavy-Duty Mobile Crane. R. G. Griffin. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 565-571. Describes the crane and some details of the welded structures. JLG (7b)

Arc-Welded Bridge Girders Tested to Failure. La Motte Grover. *Engineering News-Record,* Vol. 115, Sept. 19, 1935, pages 392-394. Two 54" plate girders, 27′ long with butt-welded flange splices, showed no distress in welds and good stress distribution among component parts up to the point of failure. CBJ (7b)

Symposium on the Welding of Iron & Steel. Vols. I and II. Iron & Steel Institute, London, 1935. Cloth, 5½ x 8½ inches, 676 and 974 pages respectively. Price £2 2s (set of two volumes).

In February, 1934, Dr. H. J. Gough of the N.P.L. suggested that information on welding ought to be brought together. The suggestion was taken up by the Iron & Steel Institute, in coöperation with 15 other technical and engineering societies, and in May, 1935, the Symposium was held, with 116 papers preprinted. The present volumes contain some 150 papers.

This was extremely quick work, and many of the papers were obviously written under pressure. A vast deal of information is included, but, with so many authors, is necessarily presented in somewhat patchy fashion. The papers were grouped under four headings: 1. Present day practice and problems of welding in the engineering industries, comprising bridge and structural engineering, pressure vessels, railway material, ship building, aeronautical, automobile, chains, electrical and heavy engineering, iron and steel castings and wrought iron. These, with a few introductory summaries and a little discussion, form vol. I.

Vol. II contains group 2, welding practice, technique and apparatus, group 3, the metallurgy of welding, and group 4, specification, inspection, testing and safety aspects.

Group 3 has 29 papers, many of which center around the problem of coatings for welding rods.

In rather disjointed fashion, a huge amount of useful information is presented and anyone interested in welding from any aspect will find several papers of value. The total of 1650 pages is a large dose, only slightly mitigated by the various introductory summaries, if one seeks to get a general view of the welding industry and its problems.

The preface, by the President of the Iron & Steel Institute, recognizes this and remarks that the Organizing Committee is considering precisely what has emerged from the Symposium, and is to draw conclusions therefrom and recommend the trend of research to improve the art and science of welding, in a report to be published later. That will facilitate digestion by the general reader of this mass of data and opinion, and will serve to temper some of the individual ideas expressed in the papers themselves. While there was some discussion, all these papers were presented in two days and there was not time for the usual amount of enlightening discussion that the English usually append to printed technical papers.

The Symposium is a mine of information and even though the ore needs concentration, it is rich ore. H. W. Gillett (7b) -B-

French Specifications for Alloy Materials for Acetylene Welding (Französische Vorschriften für die Zusatzstoffe für die Azetylenschweissung) Kemper. *Autogene Metallbearbeitung,* Vol. 28, Dec. 1, 1935, pages 363-364. The materials and their physical properties permitted in the new French standards for the various welding and brazing processes are discussed and described. Ha (7b)

Carbon Electrodes in Welding (Kohle-Elektroden in der Schweisstechnik) Golther. *Elektrowärme,* Vol. 5, Dec. 1935, pages 300-301. In general 3 C types are used, all with or without core of C powder or special additions: (1) hard, amorphous C electrodes for all purposes and normal stresses; (2) medium hard or soft, graphitic electrodes which can be used for larger currents because of their graphite content; (3) electrically graphitized carbons having the least burning loss and highest electric conductivity. They will stand twice as much current load as the amorphous C and are used where very thin electrodes are required for making thin and neat seams. All electrodes may also be used with Cu coating. Diameters required for various currents are given and the fields of application of the C arc discussed. Ha (7b)

New Welded Rail Connection (Ein neuer geschweisster Schienenstoss) H. Görlich. *Elektrowärme,* Vol. 5, Dec. 1935, pages 296-297. The 2 rail ends are butt welded with circular incisions in the foot which makes for excellent strength in the welded joint. Ha (7b)

Welded Pressure Vessels. R. K. Hopkins. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 387-398. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 16L/7. (7b)

Repairs to, and Construction of, Gasholders by Electric Welding. H. H. Hollis. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 233-241. Review of practice in England. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 16L/9. JLG (7b)

Quality of an Autogenous Weld as Dependent on Type of Welding and Subsequent Treatment (Güte der Autogenschweissung in Abhängigkeit von Schweissart und Nachbehandlung) H. Holler & H. Frankenbusch. *Autogene Metallbearbeitung,* Vol. 28, Nov. 15, 1935, pages 337-344; Dec. 1, 1935, pages 359-363. Extensive tests with different kinds of steel demonstrated the very great influence of the alloy welding rods and the effect of hammering on notch-toughness and bending angles which reached a strength of 100%. It is, therefore, imperative that in all welds of high quality, the correct welding rod is used and the seam is hammered. All experiments are described in detail. Ha (7b)

Distortion Control Procedure. David Boyd & Gordon Cape. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 39-49. Gives general outline of technique and procedure used by authors in fabricating heavy weldings. See also *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 403L/8. JLG (7b)

Ship Welding and Classification Requirements. J. L. Adam. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 667-676. Discusses welding practice in British ship yards and classification of welds. See also *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 403L/10. JLG (7b)

Welding in the Electrical Industry. E. C. Davies. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 549-555. General discussion of the relative desirability of welded structures and castings in medium and heavy electrical equipment. JLG (7b)

Micro-mechanical Study of Welds. Pierre A. Chevenard & Albert M. Portevin. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 333-352. A machine for testing small specimens in tension, shear, or flexure is briefly described. It tests specimens 1 or 1.5 mm. in diameter and stress-strain curves are plotted optically. Tests through welds in several different steels welded by several methods are described. Shear tests at short intervals along a rod taken perpendicular to the weld show the properties of the weld and the influence of welding on adjacent material. JLG (7b)

Welding in Relation to Automobile and General Repair Work. C. W. Brett. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 481-488. General discussion with particular attention to welding of automobile blocks. See also *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 402R/10. JLG (7b)

The Advantages of Welding in Structural Steelwork. Oscar Faber. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 91-94. Brief discussion of the relative advantages of welding and riveting. JLG (7b)

Design of Welded Structures with Special Regard to Erection on the Site. F. Faltus. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 95-102. Describes some structures. JLG (7b)

Continuous Welding of Exposed Mains as Applied to the Goldfields Water Supply of Western Australia. Norman Fernie & Reginald J. Keating. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 215-225. Describes application of welding to renovations of a 30" steel conduit. The original main was laid below ground and Pb jointed. To eliminate leakage and corrosion due to Pb joints and saline soils, the renovated main was laid above ground without cover and continuously welded. JLG (7b)

Principles and Application Possibilities of the Individual Electric Welding Processes (Grundlagen und Anwendungsmöglichkeiten der einzelnen elektrischen Schweissverfahren) K. Siemers. *Elektrowärme,* Vol. 5, Dec. 1935, pages 289-292. Classification of electric resistance and electric arc welding processes, their equipment and characteristics are discussed. Ha (7b)

Application Possibilities of the P-Beam by Means of Welding Technique (Verwendungsmöglichkeiten des P-Tragers mit Hilfe der Schweisstechnik) J. Sehring. *Autogene Metallbearbeitung,* Vol. 28, Dec. 15, 1935, pages 375-376. The mechanical and architectural advantages of the welded P-beam (in fact a box-type beam) are pointed out and ways to weld it together from simple structural profiles and sheets described. Ha (7b)

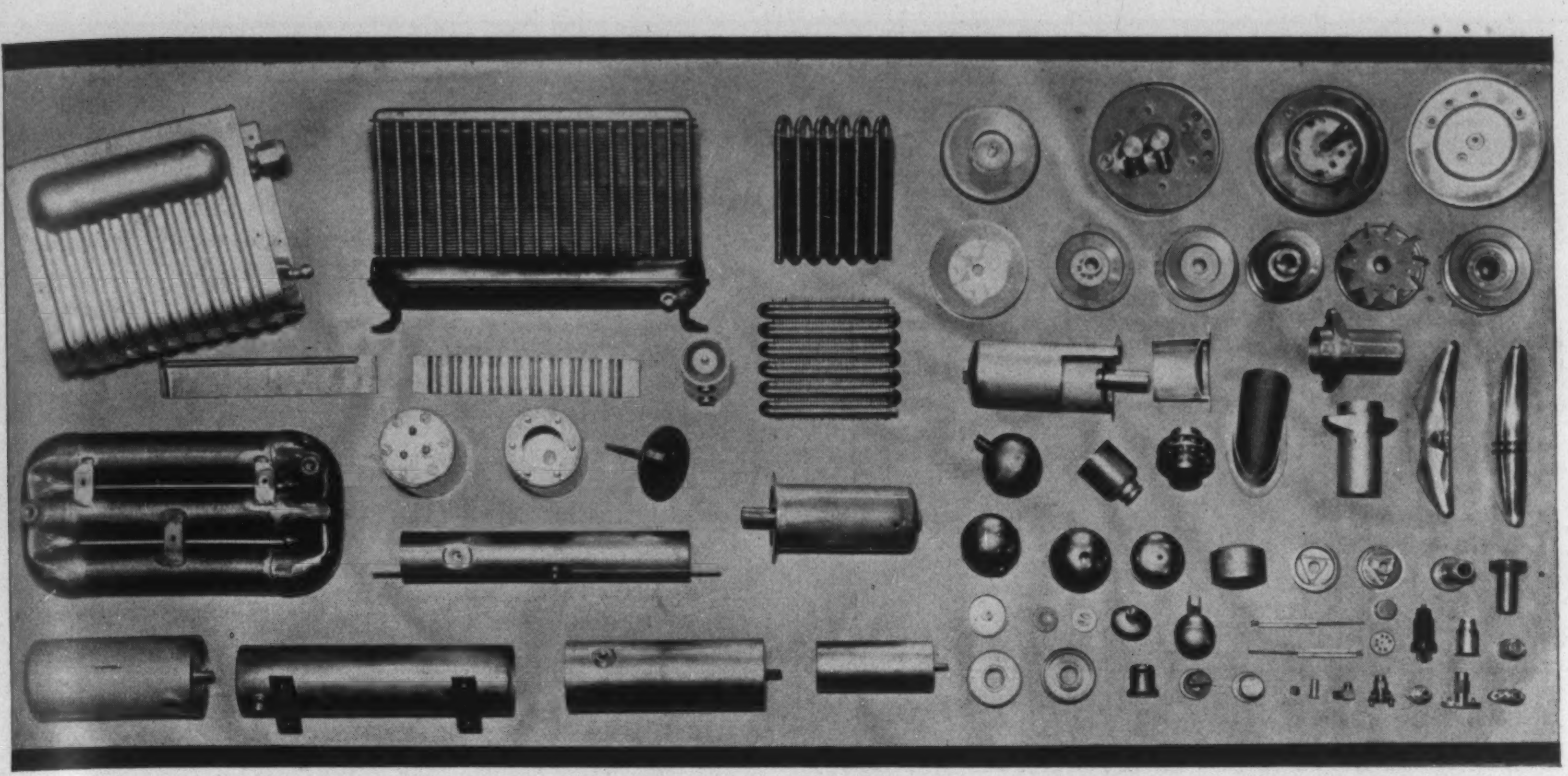
Use of Welding in the Manufacture of Freight Cars (Die Anwendung der Schweissung im Güterwagenbau) J. Schinke. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Dec. 7, 1935, pages 1459-1466. Detailed description of design and construction with tables for different types of cars with savings in weight. Ha (7b)

Importance of Research in Welding Technique (Bedeutung schweisstechnischer Forschung) W. Adrian. *Autogene Metallbearbeitung,* Vol. 28, Dec. 1, 1935, pages 353-359. The influence and value of cooperation in this field is emphasized, progress made in knowledge on effect of shape, material, processes and sequence of procedures on the quality of welds is discussed, and some particularly interesting applications for welded structures are described. Ha (7b)

The Welding of Copper. H. Martin. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 40-41. Brief notes on the operation. JCC (7b)

Fabricated Composite Dies. K. Janiszewski. *Welding Journal,* N. Y., Vol. 14, Nov. 1935, pages 7-9; *Iron Age,* Vol. 136, Dec. 12, 1935, pages 25-27. Discussion of fabrication by cutting with oxy-acetylene flame and assembly by welding. Advantages cited are lower cost by this method, variety of shape and size obtainable, rapid fabrication, delivery after 1 or 2 days, less machining, less risk of cracking in hardening, distortion correction possible at low cost, higher hardness, alteration possible without rehardening and other advantages. WB + VSP (7b)

New Method for Welding Together Ferrous Metals by Application of Heat and Pressure. Leonard C. Grimshaw. *Metals Technology,* Jan. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 667, 20 pages. Details of a new commercial method for uniting any ferrous materials are given. The material is cleaned to remove all oxide film, plated with Fe electrolytically, and welding is then performed by the application of heat and pressure. When welding 2 pieces together a metal seal is welded across the junction so that electrolytic Fe will not be oxidized in heating. Examples of high-speed steel welded to soft steel by rolling or forging are shown. Many micrographs are shown to illustrate the near perfection of the weld. The weld zone is free from non-metallics. On reheating after welding the bond is strengthened because of continued diffusion of alloying elements into the soft-Fe bond. 16 references. JLG (7b)



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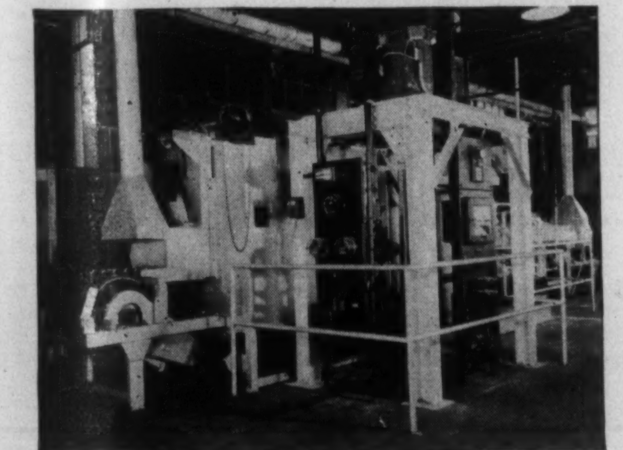

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Discussion of Paper by A. E. Gibson on "The Development And Use of Low Alloy High Tensile Steels". R. A. Bull. *Welding Journal,* N. Y., Vol. 14, Nov. 1935, pages 9-10. It is pointed out that in the case cited by Gibson of good service obtained by redesign of heavy duty clam shell buckets using welded alloy steels in place of steel castings, the most important factor was the change from poor design to good design. The implication is that properly designed steel casting would also have given good service and the satisfactory use of cast steel crankshafts is cited as example of good design and proper foundry practice. WB (7b)

Comments on Mr. R. A. Bull's Discussion of Mr. Gibson's Paper. *Welding Journal,* N. Y., Vol. 14, Nov. 1935, page 10. In particular design used for the bucket it was impossible to avoid abrupt changes in sections. It would take foundry considerable time to gain the experience necessary to produce sound casting of this design which would pay with quantity production as aim, but the item is a special order. The manufacturer guarantees the welded design against failure and considered any cast product as not 100% reliable, therefore not safe to guarantee. WB (7b)

Arc Welding. David Boyd. *Canadian Chemistry & Metallurgy,* Vol. 20, Jan. 1936, page 22. A brief discussion of a.c. and d.c. welding WHB (7b)

New Uses of Welding. C. W. Brett. *Electrical Review,* Vol. 118, Jan. 31, 1936, page 159. Electric welding has been used recently for erecting hulls of vessels; fabricating machinery and automobiles; building up worn rails, points, and crossings; joining rails to eliminate fish-plates; fabrication and repair of railway rolling-stock; repairing and strengthening bridges; reconditioning gas-holders; and repair of steel frames. MS (7b)

Modern Methods for Repairing Non-Ferrous Metals and Alloys. C. W. Brett. *Aluminum & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 38-40. Welding of Al and Cu alloys is discussed and examples of its use in repairing automobile castings illustrated. JCC (7b)

Methods of Minimizing Distortion In Light Gage Steel. J. H. Blaha. *Welding Journal,* N. Y., Vol. 14, Nov. 1935, pages 18-22. In the manufacture of food liners for electrical refrigerators, the unit is built up from formed 20-22 gage sheet steel which is required to be porcelain enameled after fabrication and welding by gas flame. C content of .02 to .04 max. is required for sheet for good enamel surface and welding rod is of same material in form of 1/8" strips clipped from sheet material. Distortion due to welding butted corners is prevented; jigs completely supporting the sheet, top and bottom and rigidly clamping all metal adjacent to weld. Closely fitting cast Fe blocks are used for jigs which are sometimes water cooled. Retraining of welders is necessary in order to turn out satisfactory sheet metal weld since welders experienced in heavy section welding must change their technique entirely to prevent burning or distorting the metal. In the discussion of porcelain firing the implication is that with best care in butt welding of the food liner it may be finally rejected due to thermal shock of porcelain and steel when firing is done in box type of furnace while in continuous type furnace the same care is given the liner as was the case in welding. WB (7b)

Welding of Porcelained Steel. J. H. Blaha. *Industry & Welding,* Vol. 7, Dec. 1935, pages 27-31. Particular precautions to observe in this work and procedure are described. Ha (7b)

Electric Welding in the Construction of Electric Furnaces (Elektroschweissung im Elektro-Ofenbau) H. Bauer. *Elektrowärme,* Vol. 5, Dec. 1935, page 295. Brief description of design details. Ha (7b)

Welding Low Alloy Steels In the Pressure Vessel Industry. E. C. Chapman. *Welding Journal,* N. Y., Vol. 14, Nov. 1935, pages 2-6. Heat treatment by stress relieving for low alloy steels is essential to bring out their superior properties. For boiler construction the 70,000 lbs./in.^{2} min. tensile strength steel is relatively new class of steel for fusion welding accepted by A. S. M. E., and is supplanting 55,000 lbs./in.^{2} material for normal boiler operation. To obtain the higher figure the C was increased to .35 max. and Mn to .90 without other alloy additions. The practical limit of C is determined by quenching effect of parent metal and the criterion of how high it should be is that sufficient ductility restoration in weld and affected zone shall be obtained after stress relief. Stress relieving temperature of weld metal controls tensile strength in same way as the draw after a quench and low alloy steels with tensile strengths up to 90,000 lbs./in.^{2} with 20% ductility in 2" are an actuality. Opinion is that 100,000 lbs./in.^{2} material with 20% ductility will soon be available. Important factors in welding low alloy steels are: (1) affinity of an element for O_2 in controlling % in weld, (2) type of rod giving large recovery and low O_2 and N_2 content in weld, (3) air hardening, (4) red shortness, (5) effect of alloy on metal pool to promote gas evolution and smooth bead. Ti found beneficial in reducing air-hardening of Cr steels but is very active and tends to burn out, Cb is less active. The use of Si in less than 1% amounts is being used in low alloy steels for oxidation resistance and this development is considered to be in the experimental stage. General discussion is made of the Ni steels of 3% or below, 5% Cr steels and the effect of Mo additions of less than 1% to C and Cr steels. In welding 5% Cr steel it is preferable to preheat to above 300° F. before welding and to anneal before structure has cooled after welding. By heating to 1400°-1550° F., furnace cool, the hardness can be dropped from 300 Brinell to below 200. Photos are shown of test specimens of 5% Cr-.5% Mo, low Mo, Cromansil, .30% Cr-1.25% Ni and low Mo-V steels together with X-ray and macro photos. WB (7b)

Welded Highway Bridge Trusses of 150-Ft. Span. George L. Dresser. *Engineering News-Record,* Vol. 116, Jan. 2, 1936, pages 40-41. Details of an all-welded bridge consisting of 2 Pratt truss spans are discussed. CBJ (7b)

Autogenous Technique in Shipbuilding (Autogentechnik im Schiffbau und Schiffbaubetriebe) Dorn. *Autogene Metallbearbeitung,* Vol. 28, Dec. 15, 1935, pages 369-375. Equipment and processes for autogenous welding and cutting are described and illustrated by examples. Ha (7b)

Test Proves Impact Value of Welds Made by the Electric Arc. A. F. Davis. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, page 19. Large scale, practical test of impact resistance of weld in 1/2" thick plate, built-up 12" box section tested by repeated dropping of 1800 lb. weight. Ductility of weld and lack of cracking is evident from photo. WB (7b)

Welding and Cutting High Chromium Steels. W J. Priestley. *Welding Journal,* N. Y., Vol. 15, Jan. 1936, pages 14-17; *Oxy-Acetylene Tips,* Vol. 14, Dec. 1935, pages 269-273; *Metal Progress,* Vol. 28, Dec. 1935, pages 56-58. Improved methods based on properties of Cr alloys. Effect of Cb and Ti on mechanical properties of Cr and Cr-Ni steels. Addition of these semi-rare elements prevents air-hardening, increases ductility, reduces annealing time and improves weldability. Oxyacetylene welding and cutting of various classes of Cr and stainless steels described. EVD + Ha + WLC (7b)

Rail Welding. L. J. Turner. *Industry & Welding,* Vol. 7, Dec. 1935, pages 13-14, 34-36. Maintenance and reforming of rails by surface fusion welding and building-up are discussed, procedures are described. Ha (7b)

The Control of Electric Resistance Welding. P. W. Townsend. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 189-196. Describes various control systems that have been developed. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 16R/4. JLG (7b)

Aircraft Constructional Welding. R. F. Taylor. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 459-464; *Sheet Metal Industries,* Vol. 9, Aug. 1935, pages 522-524. Describes English practice. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 16R/7. JLG + AWM (7b)

Prediction of Weld Performance. Nairne F. Ward. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, pages 11-15. Proper design of weld has been neglected in the past and is most important for correct adjustment of thermal stresses, especially in aircraft welding. The use of welded models for testing performance of welded section is discussed as concerns models made with same material as prototype, geometrically similar rather than made with celluloid, bakelite or rubber sections which usually show instability at the joints. The tests on scaled model are described and shown in photos. WB (7b)

Spot Welding Problems. J. H. Zimmerman. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, pages 20-25. Brief discussion of literature references on machines, electrodes, timing devices, etc. Use of Cu-W and Cu-Cd alloys for electrodes has made for progress in spot welders and new electrode mentioned using steel sheath to prevent mushrooming. Problems encountered by various investigators in obtaining good mechanical properties and in working with different materials of light gage are recounted. A review of problems under investigation at M. I. T. on spot welding of Alclad sheet is given. WB (7b)

Electrical Characteristics of the Welding Arc. S. C. Osborne. *Welding Journal,* N. Y., Vol. 14, Nov. 1935, pages 11-18. Discussion of the arcs from fundamental standpoint giving voltage distribution across the arc which is divided into 3 zones, terminal voltage drops across anode and cathode and the arc stream voltage. These 3 zones are taken up in detail along with a discussion of ionization in the arc and thermionic emission. WB (7b)

Oxy-Acetylene Cutting of Stainless Steels. W. J. Priestley. *Industry & Welding,* Vol. 7, Dec. 1935, page 64. Brief description of cutting with and without flux. Ha (7b)

Improved Fabrication of 18-8 Chromium Steels. Donald R. Pratt. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, pages 16-19. Discussion of fabrication with Cb stabilized plate and rod. Ti and Cb are considered equally effective in plate in overcoming intergranular attack but Cb for welding rod does not burn out as readily as Ti and welds therefore have greater corrosion resistance due to larger stabilizer recovery. Cb is recommended for welding ordinary, unstabilized steels also because of counteracting effect of Cb on C pickup. Where it is necessary to cross welds the Cb bearing rod deposit is protected against heat effect of the crossing weld. Precautions in welding stabilized 18-8 are to use neutral flame with flux painted on rod or seam, the use of flux paint on underside of weld is recommended as preventing oxidation. The weld should not be puddled because of excessive loss of Cb from such procedure. Other precautions in welding technique are given. WB (7b)

Definitions of Welding and Soldering Materials of Aluminum (Ueber die Begriffe der Schweiss- und Lötstoffe des Aluminiums) L. Rostosky. *Autogene Metallbearbeitung,* Vol. 28, Dec. 15, 1935, pages 377-378. The terms used for essential characteristics of basic material, flux, welding rod, and solders are defined. Ha (7b)

Some Aspects of Welding in Aircraft Construction. J. Roosenschoon. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 443-448. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 19L/1. JLG (7b)

What are the Determining Factors in Selecting an Electric Arc Welding Installation? (Welche Faktoren sind bestimmend bei der Wahl einer Lichtbogen-Schweissanlage?) Röder. *Elektrowärme,* Vol. 5, Dec. 1935, pages 293-294. The welding machine, kind of electrodes, human factor and automatic processes are discussed as to their importance in economy. Ha (7b)

Bend Testing of Welds—A Summary. M. F. Sayre. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, pages 1-10. The article summarizes the bend testing specifications now in use in various countries. The various tests are compared in tabular form, photos and diagrams illustrating methods of performance. A critical analysis of the fundamentals of bending of a weld is given as summarized from discussion in the literature. Relative advantages of different methods are pointed out and a bibliography of specifications and bend testing literature is appended. WB (7b)

Welding Galvanized Iron. V. L. Sage. *Industry & Welding,* Vol. 7, Dec. 1935, pages 20-21. Methods by the C arc and oxy-acetylene process without destroying the galvanized coat are briefly discussed. Ha (7b)

A General Purpose Meter for Resistance Welding. C. Stansbury. *Sheet Metal Industries,* Vol. 9, Nov. 1935, pages 717-719. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 16L/2. AWM (7b)

Practical Side of Resistance Welding. H. S. JEFFS. *Sheet Metal Industries*, Vol. 9, Apr. 1935, pages 231-233. From a paper read to the Institution of Welding Engineers in London. General discussion. See also *Metals & Alloys*, Vol. 6, June 1935, page MA 232R/8. AWM (7b)

Ignitron Timing of Resistance Welding. J. W. DAWSON. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 55-66. Discusses equipment used for timing of spot and seam welding. Materials successfully welded with timed welding are listed. JLG (7b)

Arc Welding in Argon Gas. G. E. DOAN & WM. C. SCHULTE. *Electrical Engineering*, Vol. 54, Nov. 1935, pages 1144-1149. Experiments made in welding of pure Fe (carbonyl Fe) in controlled pure gas atmospheres had the following results for an arc in A atmosphere: Stable welding arcs cannot be maintained in A of 99.5% purity when the electrode is clean, unless the open circuit voltage is greater than 62 volts and the short-circuit current greater than 110 amp. In air or in impure A stable arcs form readily at voltages and currents far less than these minima. No crater is formed under the iron arc in A. This condition results in complete lack of penetration into the base metal, and thus renders welding impossible. The globules at the end of the electrode grow gradually to about ¼" in diam. and detach under no apparent force except that of gravitation, and no pinch effect is observed. The melting rates/kw.hr. in A and in air are approximately equal. The pure Fe welds in A showed 90% reduction of area and 30% elongation, while the respective figures for pure Fe welds in air were only 3.5 and 4. On the other hand, the tensile strength was 40,000 lbs./in.^{2} against 65,000 in air. Apparatus used and welding are described in full, a current of 180 amp. at 10 to 12 volts was used, which varied somewhat for welds made in air and with coated electrodes. The melting rate in A was 0.922 lb./kw.hr., which is similar to that in air, 0.895 lb. The arc is quieter than in air. The tests were made with d.c. and polarities reversed. Ha (7b)

A Study of Arc Temperatures by an Optical Method. C. G. SUITS. *Physics*, Vol. 6, Oct. 1935, pages 315-322. Arc temperatures are determined by calculation from data obtained for the velocity of sound waves passing through the arc. Sound wave becomes "visible" due to luminosity of high pressure region and can be photographed with high speed camera; a spark discharge in air provides the sound wave source. Examples of the photographed waves are shown. At 5500° K. the calculated error due to uncertainty in reading wave shape, calibration errors, motor speed (for rotating mirror of camera), etc., is ± 100°. The arc materials, Cu, cored projection C, NaCl-cored C, Al-cored C, W-cored C, 6 mm. W, 9.5 mm. W, W welding arc, coated Fe welding arc are tabulated as to temperature in °K., electron density and effective ionization potential. The temperatures have a spread from 4000°-7000° K. W welding arc temperature and coated Fe welding arc temperature are 6150° and 6020° K. respectively. In the latter the current density using 125 amps. varied between 94 and 405 amps./cm.^{2} and temperature fluctuated between 4400° and 7000° K. (by estimation) with an average temperature of 6000°. Type W-20, coated welding rod is represented as most stable arc in common use. Arc stability is affected most by small amount of vapor of low ionizing potential, which lowers arc temperature and decreases gradient; it also affects the current density. The low ionizing potential vapor is supplied by coating material of the welding rod. The absence of dissociation processes in monomolecular A gas is considered to be the cause for unsuccessful attempts to arc weld in pure A atmosphere (Doan & Schulte, *Physical Review*, Vol. 47, 1935, page 783). WB (7b)

Results Recently Achieved by Research on the Oxy-Acetylene Welding of Mild-Steel. L. C. PERCIVAL. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 471-474. Cites results obtained with remarkable new welding rod, but does not tell what rod is. JLG (7b)

The Physical Properties of Electrode Coatings. J. H. PATTERSON. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 453-462. Describes behavior of a rod when coated with different materials and then used as an electrode. JLG (7b)

Welded Pipe Lines in Hydro-electric and Other Schemes. D. ROSS. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 289-298. Describes methods of making and joining large welded pipe in England. JLG (7b)

Apparatus for Automatic Arc-Welding. E. ROSENBERG. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 155-159. Shows where automatic arc welding is applicable and then describes a machine used for this type of welding. JLG (7b)

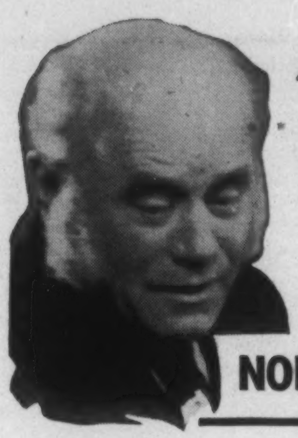
The Strength of Welded Connections. M. ROS & A. EICHINGER. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 843-866. Gives and discusses data on static and dynamic strength of welded connections. JLG (7b)

The Varying Mechanical Quality of Fusion-arc and Oxy-acetylene Welds of Mild Steel Plate, and the Effect of Normalising Thereon. R. T. ROLFE. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 539-552. Gives data on unwelded plate, plate welded by different methods, and plate normalized after welding. JLG (7b)

The Significance of Welding Tests. W. D. HALSEY. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 803-809. Discussion of tests of welds and their significance. JLG (7b)

Some Notes on the Welding of Mine Haulage Gear. J. H. ANDREW & W. A. JOHNSON. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 503-506. Describes manufacture and defects sometimes found in haulage gear. Wrought Fe is recommended for the manufacture of welded couplings and chain. JLG (7b)

Bridge Welding—A Review of the Literature. F. H. FRANKLAND. *Welding Journal*, N. Y., Vol. 14, Oct. 1935, appendix pages 1-16. An evaluation of the pertinent literature from 1926-1935 in the form of abstracts and a short introduction. WB (7b)



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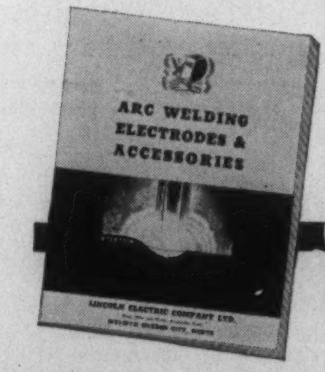
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Application of Welding for the Construction of Houses. M. Mopin. *Welder,* Vol. 7, Nov. 1935, pages 737-749. Problems of materials, semi-inoxidizable steels, arc welding methods and workmanship are discussed and examples given. Ha (7b)

1 **Repair of a 200 Ton Press (Reparation sur place d'une presse de 200 tonnes).** R. Meslier. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Aug.-Oct. 1935, pages 1873-1879. Lecture before the Société des Ingénieurs Soudeurs. Repair of the cast steel frame by means of bronze welding with reinforcement of repaired portion by means of an arc welded steel plate on each side of the frame. 2 cast Fe flywheels were also repaired. The broken portions were very numerous and bronze welding as well as arc welding was resorted to with various types of weld preparations and different kinds of added metals. Much difficulty was met with in repairing a fly wheel hub which was broken at the key groove. The repaired press has been in service for several months. FR (7b)

2 **Beautiful Welded Constructions (Les Belles Constructions Soudées).** R. Meslier. *Revue de la Soudure Autogène,* Vol. 25, Nov. 1935, pages 12-13. Examples described are cracking towers having 2.8 m. diameter and 23 m. height and weighing 60 tons built by French plant of Babcock and Wilcox. FR (7b)

3 **New Arc Welding Method (Ein neues Lichtbogen-Sonderschweissverfahren).** R. Hessler. *Die Wärme,* Vol. 58, Aug. 10, 1935, pages 511-519. A new welding method (German Patent No. 567 094) developed by the Krupp Works has been admitted by the German Welding Specifications on the Construction of Boilers. An austenitic Cr-Ni welding electrode is utilized for the pearlitic-ferritic boiler material of 0.3% C max. The nature of the welding method, microstructures, results on impact, tensile bending, forging, hardness, hydraulic and corrosion tests are reported. EF (7b)

Butt-Welding Avional (Duralumin) Electrically saldatura elettrica di testa dell'avional). M. Bosshard. *Alluminio,* Vol. 4, July-Aug. 1935, pages 219-221. 3 rods of duralumin, butt-welded electrically, were found to have the following properties: elastic limit 28.5 kg./mm.^{2}; tensile strength 37.2 kg./mm.^{2}; elongation (200 mm.) 1.7%; Brinell hardness 117 average. AWC (7b)

4 **Some Applications of Fusion Welding (Quelques Applications de la Soudure Autogène).** R. Granjon. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Aug.-Oct. 1935, pages 1838-1872. Lecture before the Société des Ingénieurs Soudeurs. Describes typical applications of fusion welding and with help of numerous illustrations shows the tremendous development of applications of welding process. FR (7b)

5 **The Welding of Chassis Frames.** H. S. Bavister. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 473-479. Describes welding in English plant by Sciaky spot-welding process. In this process the parts to be welded are held together by a pressure of about 20,000 lb./in.^{2} before and after the welding current and by a smaller pressure during the passage of the current. See also *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 495L/5. JLG (7b)

6 **Shipbuilding by Welding.** Norman M. Hunter & H. W. Townshend. *Welding Journal,* British, Vol. 32, Nov. 1935, pages 346-348; *Electrical Review,* Vol. 117, Nov. 22, 1935, page 710. An account of construction of all-welded 245 foot tanker Moira and the application of welding to smaller trawlers. For large butted seams in plating 2 welders start in middle and work toward opposite ends of the plate. Welding in shipbuilding is important in overcoming fatigue failure of constantly vibrated parts, petroleum leaks in tankers through riveted seams, water seepage through riveted seams in deck and hull plating. Discussion shows welding eliminates punching, drilling, riveting and calking of ship shell. MS + WB (7b)

7 **When is Resistance Welding Applicable?** M. L. Eckman. *Machinery,* N. Y., Vol. 42, Jan. 1936, pages 297-301. Resistance welding in the form of spot, projection, seam, flash and butt welding is discussed from the point of view of what metals can be welded, where resistance welding is applicable and what must be the manufacturing conditions to make it applicable. Examples illustrate choice and economy of the various types of resistance welding. Ha (7b)

Welding High Pressure Steam Piping at U. S. Industrial Alcohol Co. Plant. J. A. Freiday. *Heating, Piping & Air Conditioning,* Vol. 7, Dec. 1935, pages 568-569. Review of reconstruction project involving acetylene welding of pipe 2" to 14" O. D. Discussion of welder qualification, testing of welds and stress relief. WB (7b)

8 **Welding in the Construction of the "Normandie."** W. Faerman. *Welder,* Vol. 7, Sept. 1935, pages 685-694. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 16L/5. Ha (7b)

Welding Repair Saves Bridge Badly Damaged by Smoke Corrosion. *Steel,* Vol. 98, Jan. 13, 1936, page 39. Corroded portions of stringers of bridge in Cleveland, O., were chipped away to expose sound metal. Lengths of steel plate were inserted between stringers, arc welded in place, and openings filled with weld-metal. Smoke plates were then welded to top and bottom to protect stringers from further corrosion. MS (7b)

9 **Air-Acetylene Method is Widely Used When Low Temperature Flame Is Needed.** *Steel,* Vol. 97, Oct. 7, 1935, pages 35-36. See "More Uses for Air-Acetylene Flame," *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 18L/10. MS (7b)

Studies Throw Light on Thermal Effect of Welding Structural Steel. *Railway Age,* Vol. 99, Dec. 21, 1935, pages 816-818. Tests indicate the presence of stresses but show that efficiency of metal is not seriously affected. CBJ (7b)

10 **Oxy-Acetylene and the Open Hearth.** *Iron & Steel of Canada,* Vol. 18, Dec. 1935, pages 88-90. The progress from 1901 to 1935 in the use of cutting and welding in the open hearth production of steel is reviewed. Ha (7b)

Porosity in Weld Metal. *Engineer,* Vol. 160, Dec. 13, 1935, pages 631-632. From the Technical Report for the years 1933-1934 of the British Engine, Boiler and Electrical Insurance Company, Limited. LFM (7b)

Automatic Welding of Food Compartments. H. Thomasson. *Canadian Machinery & Manufacturing,* Vol. 46, Aug. 1935, pages 37-38. Canadian Welder Section. Flexarc welder with a.c. of 100-125 amps. and superimposed high frequency current is used. The high frequency current carries the arc over the zero voltage part of the a.c. cycle. With this arrangement, a.c. is preferred to d.c. because of entire elimination of arc blow, higher welding speeds, sounder welds, more economical welding and less skillful operator required. Heavily coated $\frac{1}{8}$" electrodes are used which are principally gas-shielded and leave little slag. Heavy slag-producing coatings were found conducive to entrapped slag in the weld due to the low current employed; the slag gave trouble in enameling. Preparation for enameling consists in sand blasting welds and bosses, pickling the entire compartment followed by a black vitreous ground coat and two white coats, the last coat being acid resisting. New method reduced enameling rejects from 10% to less than 1%. WB (7b)

Gas Absorption by Welds (Etude de l'Absorption des Gaz par les Soudures). D. Seferian. *Revue de la Soudure Autogène,* Vol. 27, Nov. 1935, pages 4-10. O and N are present in steels as impurities. Welding which involves melting of the metal causes absorption of these 2 gases and ultimate properties of welds are affected thereby. Gas absorption is dependent upon numerous factors and chiefly upon welding method. With oxy-acetylene welding, there is little gas absorption, a maximum of 0.05% O and 0.02% N; hence, weld properties are little affected. This is due to the properties of oxy-acetylene flame. With arc welding, gas absorption is much more important and varies according to nature and thickness of electrode coating and electrical conditions of arc. In worst conditions following results are obtained: 0.30% O and 0.20 N (electrodes without coating and very long arc). In best conditions, absorption would be: 0.07% O (electrodes evolving H) and 0.03% N (thick coating). Following this, mechanical properties and particularly impact resistance of arc welds are considerably lowered by gas absorption. Author has also shown that N acts as a hardening element giving new compounds; properties of nitrided welds of very low C steels are much affected by heat treatment. FR (7b)

New Application of Atomic Hydrogen Welding (Une Application Nouvelle de la Soudure à Hydrogène Atomique). Maurice Lebrun. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Aug.-Oct. 1935, pages 1907-1913. Lecture before the Société des Ingénieurs Soudeurs. First gives principle of atomic H welding. Application described is the repair of a heavy bronze propeller wheel which had been worn out by erosion. Whereas end of propeller wings can be easily welded by means of torch, problem met with is quite different when erosion happens on thick part of the propeller near the hub. Atomic H welding has been resorted to with success in this case. It is emphasized that it will probably be possible to increase life of screws by depositing through welding harder and more corrosion resistant metal on parts where erosion always occurs. FR (7b)

Controlling Heat Effects in Welding. *Mechanical World & Engineering Record,* Vol. 98, Aug. 2, 1935, page 101. In general, heavy castings should be totally preheated before welding with the object of avoiding bad alignment. On plant repair work, this is sometimes next to impossible and interesting solutions to the problems then arising are given. WH (7b)

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Materials and Methods in Built-up Welding. GÜNTER ERBER. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 89-96; *Iron & Coal Trades Review*, Vol. 130, May 24, 1935, page 889. Shows why repaired parts have failed and discusses precautions to be observed in order that failures may be avoided. 16 references. JLG + Ha (7b) 1

Welded Pressure Container Construction in the United States. E. R. FISH. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 227-231. Review of fabrication, testing and use of welded pressure containers. JLG (7b)

Steel-concrete Construction. R S. EADIE. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 79-89. The structure referred to is made by forming a light steel framework by welding and then encasing in concrete. Advantages of such a structure are discussed and methods of calculating its strength are given. JLG (7b) 2

Some Notes on the Selection of Electric Arc Welding Plant. R. W. HAPPÉ. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 105-114. Discusses the applicability of different types of equipment for various services. JLG (7b)

The Present Situation of Welding in Structural Engineering in Austria. FRIEDRICH HARTMANN & KARL GIRKMANN. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 109-116. Discusses building code applying to welding and cites instances where welding was used in fabrication of buildings and bridges. 3 JLG (7b)

The Application of Welding in the Manufacture of Electrical Machinery. H. W. HAWKINS & J. DONKIN. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 573-582. Discusses use of metallic-arc and resistance welding in electrical industry in England. JLG (7b)

Lessons Learned in Welding a Steel-Plate Bridge Floor. H. H. HAWLEY & J. C. MERRELL. *Engineering News-Record*, Vol. 115, Oct. 3, 1935, pages 472-474. 4 Distortions in floor beams and chords caused by shrinkage in floor-plate welds may be eliminated by a minimum of transverse welds, by postponing stringer-floor beam connections until plate welds in panel are complete, and by peening each pass of a weld before it has cooled. CBJ (7b)

Various Mild Steel Electrodes and Their Characteristics—Some Practical Aspects. ELIS HELIN & SVEN SVANTESSON. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 373-390. Reactions during welding both with and without coatings are described. A wire with a light coating may show little difference from a bare wire. 5 With heavy coatings strong ductile welds with a high impact resistance are produced. The function of the coating is mainly to prevent oxidation of the stream of metal in the arc and to prevent N absorption. JLG (7b)

The Welding Research Programme of the Steel Structures Research Committee of the Department of Scientific and Industrial Research. H. J. GOUGH. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1. pages 103-108. Outlines program being carried out at National Physical Laboratory. Properties and testing of welds are being studied. JLG (7b) 6

On the Fatigue Strength of Constructional Members, and Particularly of Welded Joints. O. GRAF. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 791-794. Discussion of the actual fatigue strength of welded members and the factors that contribute to low fatigue values. JLG (7b)

Metallurgical Fundamentals of High-Speed, High-Quality Autogenous Welding. A. B. KINZEL. *Sheet Metal Industries*, Vol. 9, Oct. 1935, pages 649-650, 652. From a paper at the recent Symposium on the Welding of Iron and Steel. A discussion of three fundamental requirements: 7 (1) Mechanical homogeneity, termed "complete fusion"; (2) deposited and base metal of high strength and ductility; (3) freedom from internal stresses of a high order of magnitude. AWM (7b)

The Chemical Composition of Welding Rod and Its Change During Welding. K. L. ZEYEN. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 2, pages 617-633. German specifications for welding rods are shown. Compositions of welds made from different rods and prepared by different practices are given. Factors influencing composition and properties of the weld are discussed. 8 See also *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 495L/8. JLG (7b)

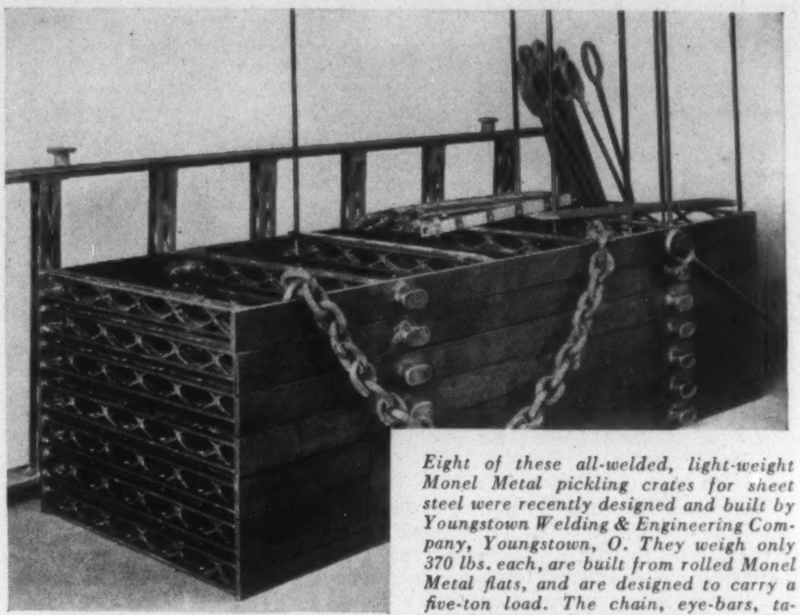
Glance at Welding Applications at the Last French Automobile Show (Coup d'oeil sur la Soudure au Salon de l'Automobile). R. SALLELES. *Bulletin de la Société des Ingénieurs Soudeurs*, Vol. 6, Aug.-Oct. 1935, pages 1903-1906. Lecture before Société des Ingénieurs Soudeurs. Article pointing out some new peculiarities about welding in motorcar construction. FR (7b)

Flame Cutting and Its Applications. A. USSHER. *Welding Engineer*, Vol. 20, Nov. 1935, pages 20-25. Technique of flame cutting, consumption of acetylene 9 and gas, speed of cutting for various materials and thicknesses and advantages in making up structures instead of using castings are discussed. Ha (7b)

The Increasing Use of Resistance Welding. J. A. WEIGER. *Machinery*, N. Y., Vol. 42, Dec. 1935, pages 241-243. Possibilities of spot-welding for simplification in manufacturing processes are discussed, types of welding machines, welding processes mostly used, and materials for electrodes and dies are described. Ha (7b)

Arc Welding for Multiple Story Steel Frame Structures. A. RAMSAY MOON. *Structural Engineer*, Vol. 13, June 1935, pages 267-276. Paper before the 10 Scottish Branch of the Institution of Structural Engineers, March 1935, discusses and abundantly illustrates the following points: structures with beams freely supported, stanchion caps and bases, column splices, beam connections, beam brackets, plated beams and stanchions, structures with rigid joints, design of rigid joints. WH (7b)

WELDED TRUSS DESIGN PICKLING CRATE SAVES 63% DEAD WEIGHT



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MONEL METAL

Arc Welding Costs Reduced by Cross Field Principle. M. S. HANCOCK. *Iron Age,* Vol. 136, Dec. 5, 1935, pages 38-39, 106. Describes new cross field generator developed by Westinghouse Electric & Manufacturing Co. It hinges on 2 basic requirements; load regulation and no mutual inductance between exciting and differential field coils. Operating on cross field principle it can be preset for a given welding current which it maintains. Marked reduction in number of parts is also a feature of new design. VSP (7b)

Welding Machines for Assembling Automobile Parts. C. M. TAYLOR. *Machinery,* N. Y., Vol. 42, Nov. 1935, pages 175-176. Describes hydraulically operated machines. Ha (7b)

Welding in Marine Engine Frames. C. H. STEVENS. *Symposium on Welding of Iron & Steel,* Organized by Iron & Steel Institute, May 2-3, 1935, 6 pages. Discussion of engineering features. JLG (7b)

Warping of Continuous Welded Track (Sicherheit gegen Verwerfung im durchgehend geschweissten Gleise). HUBERT LEDERLE. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 90, July 1, 1935, pages 235-238. A mathematical treatment of the stresses occurring and danger of warping in vertical and lateral direction. EF (7b)

Adhering Lead Coating (Le Plombage Adhérent). *Soudure et Oxy-Coupage,* (Supplement to *Revue de la Soudure Autogène*), Vol. 12, Nov.-Dec. 1935, page 275. Deposition of Pb by means of oxy-acetylene torch is explained and illustrated. Technique of the process is given. (7b)

Welding of High Strength Steels (Das Schweissen von Stählen höherer Festigkeit). K. L. ZEYEN. *Stahl und Eisen,* Vol. 55, Aug. 22, 1935, pages 901-906. Weldability limit of plain C steel was formerly held to be at 0.35% C but with good coated electrodes 0.55% C steel can be welded. In gas welding, however, difficulties may appear at about 0.3% C. Lowering the C and raising the Mn gives a higher strength steel which can be welded without cracking. Where corrosion resistance does not play a part austenitic steel electrodes can be used on ferritic alloyed or unalloyed steels. See also *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 495L/7. SE (7b)

Frisco Combines Joint-Bar with Rail End Welding. *Railway Engineering & Maintenance,* Vol. 31, Oct. 1935, pages 656-659. Starting in a small way, the St. Louis-San Francisco has developed an extensive program of rail and joint reclamation by oxy-acetylene welding, which will eventually include all battered rail and worn angle bars in the main tracks. The sequence of the various synchronized operations which have been developed on this road are fully described and illustrated. WH (7b)

Modern Welding Machines Show Pronounced Savings in Operation. J. F. LINCOLN. *Steel,* Vol. 97, Aug. 19, 1935, pages 40-41. New welding machines have 60% higher capacity than old welding sets, and 10% greater efficiency at full load, and deliver uniform current. Cites some examples of savings made by the new welders. MS (7b)

Welding of Thick Aluminum (La Soudure de l'Aluminium Epais). *Soudure et Oxy-Coupage,* (Supplement to *Revue de la Soudure Autogène*), Vol. 12, Nov.-Dec. 1935, page 276. Special precautions to be taken for welding thick Al are explained for practical men. FR (7b)

Question of Conventional Designations in Welding (Etat Actuel de la Question des Signes Conventionnels en Soudure). MAURICE COUTURIER. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Aug.-Oct. 1935, pages 1880-1902. Report before the Société des Ingénieurs Soudeurs about International Conference of Würgburg, Oct. 26, 1935. Author compares French standardization project with international one. He concludes that despite differences of practical presentation, principles on which methods are based are the same and will lead to easy cooperation between different countries. FR (7b)

Automatic Welding (La Soudure Automatique). *Revue de la Soudure Autogène,* Vol. 27, Nov. 1935, pages 14-15. Description of a "Sa Frap" machine for end joining of hollow cylindrical bodies by double side welding. FR (7b)

Qualification Tests for Pipe Welders. *Welding Engineer,* Vol. 20, Nov. 1935, pages 28-30. A discussion of the American Standards Association Code with suggestions to those directly affected by its provisions. Ha (7b)

7c. Riveting

Riveted Pipe Lines. E. W. HOWELLS. *Structural Engineer,* Vol. 13, Oct. 1935, pages 404-411; *Mechanical World & Engineering Record,* Vol. 48, Nov. 1, 1935, pages 425-426, 428. Paper before the South Western Branch of the Institution of Structural Engineers at Torquay, Jan. 1935. The construction of large pipe lines in places remote from workshop facilities raises problems of transport and manufacture as well as of erection. Economy demands that plates be shipped flat which means fabrication near the site. The careful planning required by this type of work and the usefulness of riveting are fully considered and the erection of a large pipe line in India is described at great length. WH (7c)

High-Speed Riveting Fixtures. WM. C. BETZ. *Machinery,* N. Y., Vol. 42, Nov. 1935, pages 177-180. Multiple riveting machines able to give up to 1000 blows a minute are described. Ha (7c)

Special Riveting in Aeronautical Construction (Le rivettature speciali nelle costruzioni aeronautiche) P. DEL PONTE. *Alluminio,* Vol. 4, Nov.-Dec. 1935, pages 331-340. Expanding rivets are preferable in most cases because they can be applied more quickly and economically. AWC (7c)

Standard Specifications for Riveted Steel and Wrought-Iron Pipe. *American Society for Testing Materials,* A. S. T. M. Designation: A138-34; *American Standards Association,* A. S. A. No.: B36.8-1935, 3 pages. AHE (7c)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Finishing Vacuum Cleaner Parts. F. L. PRENTISS. *Iron Age,* Vol. 136, Nov. 28, 1935, pages 34-35, 84-85. Description of finishing method for Royal cleaners made by P. A. Geier Co. Permanent mold and sand castings of No. 12 Al alloy containing 95% Al are used. Polishing and buffing equipment consists of 30 lathes. Lubricated felt wheels are used for polishing Al, but no lubricant is used for polishing steel. Buffing wheels are made of fine-count muslin sheeting. Steel stampings are heavily plated with Cu, color buffed and Ni plated. VSP (8)

Finishing Methods Are Improved. *Steel,* Vol. 98, Jan. 6, 1936, pages 226, 327-329. Presents opinions of various authorities on accomplishments of the finishing industry in 1935. MS (8)

8a. Pickling

Reclaiming Disused Cans. C. C. DOWNIE. *Electrical Review,* Vol. 118, Feb. 14, 1936, pages 245-246. Describes an electrolytic method for cleaning paint and varnish cans. Principle is that gas bubbles formed at anode separate adhering paint skin from metal. Current sufficient to produce only desired amount of gas bubbles is used. Cans are placed upside down in open wooden cages with Cu connection for current to anode. Canister, suitably coated with graphite wash, serves as cathode. Electrolyte which will provide greatest amount of bubbles is most suitable. Generally, different concentrations of soda are most effective. Electrolyte is caused to flow through a filter. Voltage seldom exceeds 12 volts. Average can needs about 5 min. at a density of 200 amps. per can. MS (8a)

8c. Polishing & Grinding

Safety Devices for Grinding and Polishing Machines (Sicherheitsmassnahmen an Schleif- und Poliermaschinen) BRAUER. *Oberflächentechnik,* Vol. 13, Jan. 21, 1936, pages 17-18. Special arrangements are shown for eliminating injuries to workmen on polishing and grinding machines with projecting shafts with interior thread; fingers of the worker were often caught in the thread. Ha (8c)

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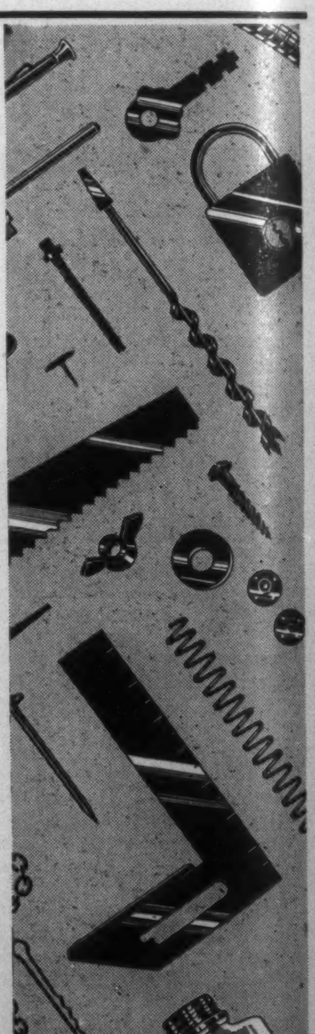

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■ 8d. Electroplating ■

The Electrodeposition of Chromium. E. A. OLLARD. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, May 17, 1935, pages 541-542; Vol. 47, July 26, 1935, pages 89-91; Aug. 23, 1935, pages 185-188. Chief uses of Cr are as a nontarnishable finish and a wear-resistant surface. Process is the same for both applications but more care is required for the thicker deposits necessary to withstand wear. The theory of electrodeposition is discussed together with mechanism of reaction, cathode reactions, formation of sulphate, its importance and its possible functions. The composition of the plating solution, methods of preparation and means of making sulphate additions are considered. The author does not favor additions of boric acid, chromic carbonate, borates, Cu salts, etc. which are sometimes recommended. His experimental data indicate that fluoride might be substituted for sulphate but no detailed research or commercial application of its use are yet known. A method of preparing and aging the solution when laboratory facilities are not available is suggested. The method of operating the solution is described. The importance of careful regulation of current density at the cathode, and the necessity for an adequate supply of current at the vat bus-bars are noted. Anodes, usually Pb or a Pb-Sb alloy, must be kept clean to insure good contact or unsatisfactory plating will result. The author considers the method of suspending the work one of the most important factors and one of the most difficult to describe. Heavy conductors are required as Cr-plating requires a high current density. Simple wiring, such as is used for other plating, is unsatisfactory as the heavy solution necessary tends to form insulating layers. For protecting portions of work not to be plated, soldering or the use of special jigs is suggested. Auxiliary anodes are sometimes used to advantage. The preliminary treatment varies but most material to be given a bright Cr-finish is Ni-plated and polished. It is then degreased by a trichlor-ethylene process and placed in the vat dry or else cleaned electrolytically, washed thoroughly in water of the temperature of the plating bath and put into the vat wet. The author prefers the latter method although both give good results. The subsequent treatment is outlined. Although the solution used is of a complex nature, it is not difficult to control as impurities, for the most part, do not play an important part in Cr-plating. The 3 factors to be controlled are the chromic acid or chromate content, the trivalent Cr, and the sulphate. Of these, only the sulphate must be determined by analysis. The other 2 factors, chromate content and trivalent Cr, may be determined from the specific gravity and conductivity of the solution. Methods for the adjustment of these factors are suggested. The control of the sulphate is the most difficult as it is not easy to determine whether the solution is deficient in sulphate or contains an excess. In the former case, addition of H_2SO_4 will correct the trouble, but in case of an excess, the trouble may be corrected by additions of Ba chromate, carbonate, hydroxide, or oxide. HBG (8d)

Some Peculiarities in Formation of Metallic Deposits (Quelques particularités de la formation de depôts métalliques) JEAN BILLITER. *Revue de Métallurgie,* Vol. 32, Nov. 1935, pages 518-521. At very low current densities, electrolytic deposition occurs only along grain boundaries of the base metal or along scratches present on them. There is no need for the space lattice dimensions of the deposited metal to be the same as in the base in order that the crystalline structure of the two shall be continuous. Forces of attraction have a pronounced influence here. The general opinion that these forces can extend to very short distances, of molecular order, is not consistent with the fact that the presence of an unoriented layer between the base and the oriented crystals of the deposit is easily visible under a microscope. When higher current densities are used, it happens occasionally that roughness originally produced on the surface deposited with low current density steadily persists. A theory is advanced that the film of electrolyte near the surface of the base which is impoverished by the current is of about the same thickness as the nuclei of deposited metal originally deposited and that it does not reproduce exactly all unevennesses of the surface. In this case, nuclei protruding through it closer to the normal electrolyte lead to an increasing precipitation in corresponding areas. The theory is supported by an experiment in which the current carried by two similar wires immersed in an electrolyte and electrically connected with a common anode was different depending on whether the wire, insulated on the outside, was pointing to the anode with its bare cross section or the end of it was inserted in an insulating plug so as to expose the same bare cross section. JDG (8d)

Mechanism of Brass Plating. C. B. F. YOUNG. *Steel,* Vol. 97, Dec. 23, 1935, pages 31, 34. In brass plating, it is necessary to have the normal cathode potentials of Cu and Zn equal or nearly so, in order to deposit the 2 metals simultaneously. Sulphate solutions are not commercially feasible because of the wide difference in potentials. Cyanide baths are practicable because of the close potentials of Cu and Zn in this solution. By forming double cyanides, potential of Cu is reduced much faster than that of Zn, until they become practically equal. This is especially true if excess cyanide is present. To deposit same composition of brass continuously, concentration of Cu, Zn, free cyanide, etc. must be maintained constant. Rate of solution of Cu and Zn at anode must equal rate of deposition at cathode. Increase of free cyanide content gives less Cu in brass, while decrease gives more Cu. Increasing current density increases Zn in alloy. Raising temperature increases Cu in alloy. pH of bath should be about 11, determined calorimetrically. If solution is too acid, NaOH or NH_4OH should be added. If it is too basic, dilute H_2SO_4 should be added. Best indicator is prepared by dissolving 0.6 gram thymolphthalein and 0.1 gram phenolphthalein in 300 cc. of 50% C_2H_5OH. Cathode and anode efficiencies should be as high as possible and equal to each other. All baths should be analyzed periodically to detect changes taking place and corrections made accordingly. MS (8d)

Practical Hints from the Gold Coating Wire Shop (Aus der Praxis der Drahtvergolderei). A. WOGRINZ. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Nov. 1, 1935, pages 455-456. Formulae for most efficient Au plating method, pretreatment of wires, bath composition, preparation of Au-chloride. EF (8d)

Improvement in the Quality of Tinplate by Superimposed Electrodeposition of Tin. A. W. HOTHERSALL & W. N. BRADSHAW. *Technical Publications of the International Tin Research & Development Council,* Series A, No. 22, 1935, 16 pages. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 499L/1. (8d)

A Study of Diffusion on Copper Plated Zinc-Base Die Castings. WILHELM F. CASTELL. *Transactions Electrochemical Society,* Vol. 66, 1934, pages 427-440. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 365L/8. (8d)

Some Further Principles of Electrochemistry Applied to Electrodeposition. No. IV. Ostwald's Law of Dilution. SAMUEL FIELD. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 45, Nov. 16, 1934, pages 473-475. A parallel is drawn between the development of the science of electrochemistry and the development more than a century ago of the simple laws of chemical combination. Then, as now, general laws were based on studies of simple salts and, when necessary, amplified as more complicated reactions were studied. Using a simple electrolyte, NaCl, the author developed a formula for K, dissociation constant, which represents the ratio of the tendency of a molecular substance to ionize to the tendency of the ions to recombine. For weak electrolytes, such as acetic acid and monochloracetic acid, fairly constant values for K are obtained. The author states that this simple relation between degrees of dissociation at different states of dilution, known as Ostwald's Law of Dilution, is of general application for all electrolytes which do not freely dissociate in solutions of moderate dilution. For strong electrolytes the value of K is not constant which is attributed to other factors which, it is believed, have a more intimate bearing on electrodeposition than has the dissociation constant. HBG (8d)

Practical Plating. Deposition of Copper: II. Acid Copper Solution. E. A. OLLARD & J. W. PERRING. *Metal Industry,* London, Vol. 45, Nov. 2, 1934, pages 423-424; Nov. 30, 1934, pages 519-521. The acid solution containing $CuSO_4$ and H_2SO_4 is used when a thick deposit of Cu is desired. While it cannot be used for plating directly on Fe, steel, or certain other metals, such as Zn, it has the advantage over the cyanide solution in that in addition to plating it may be used for electrotyping and electroforming. When used in the latter types of work, precautions must be taken to move the objects during deposition and to agitate and circulate the solution. The theory underlying the operation of the solution is discussed together with the necessity for the addition of H_2SO_4 at intervals. The constituents of the solution, its method of preparation and certain precautions to be observed are discussed. "Addition agents," such as glue and phenol-sulphonic acid, are used when smooth, hard deposits with a fine grain structure are required. Phenol-sulphonic acid is considered to be the only satisfactory addition agent, and a method of preparing this compound is given. Results obtained indicate that phenol-sulphonic acid itself is not the active agent but rather an unknown decomposition product formed by electrolysis in the bath itself. It is emphasized that good Cu deposits are obtained only when suitable anodes are used. "Electrolytic" Cu, 99.9% purity is recommended. Small quantities of Fe and O are not considered harmful impurities, but As, Sb, Bi and Ag are considered detrimental and should not be present in excess of 0.01%. The physical properties of the anode are also important. The author suggests anodes that have been melted and rolled as hard as possible with proper annealing and pickling between passes. He recommends, however, an extruded anode that has recently come on the market. The method of operating the solution is discussed together with the results of using "hot" and "cold" solutions. Control of the solution is not difficult and may be done by determining the density and acidity of the solution. The effect of impurities in the solution, possible sources of these impurities, and method used for their removal are also considered. HBG (8d)

The Deposition of Zinc Cadmium Alloys from Alkaline Cyanide Solutions. LESLIE WRIGHT & J. RILEY. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 45, Nov. 16, 1934, pages 471-473. See *Metals & Alloys,* Vol. 6, July 1935, page MA 288R/5. HBG (8d)

Barrel Plating Technique. E. J. DOBBS. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, July 12, 1935, pages 41-42. Paper before Electrodepositors' Technical Society, June 12, 1935. Types of barrels used are (1) perforated containers for the articles to be plated placed in the tank containing the solution, (2) self-contained barrel and vat, not perforated, and (3) combination of types (1) and (2). The types of barrels, methods of operation and materials of construction are discussed. The conditions of deposition in barrel-plating are compared with the conditions in still plating and the necessary subsequent treatment is indicated. HBG (8d)

Air Conditioning of Lacquer and Plating Rooms. A. W. KNECHT. *Monthly Review American Electroplaters' Society,* Vol. 22, Nov. 1935, pages 22-32. Advantages of air conditioning are; fewer rejections, improved work with no increase in workmen's time, better morale and less time lost by respiratory diseases. Operations in the lacquer room are hampered on humid days by "blushing" of lacquer films before they dry. A conditioned atmosphere prevents blushing by keeping moisture content at a low value. Conditioning also removes all dust particles and thus eliminates another lacquer room problem. The air conditioning system itself is considered as follows:—(1) quality of the air, (2) distribution of the conditioned air. Under (1) are considered changes in the heat and moisture content and methods of accomplishing these changes. Under (2) are the unit and central types of distributing systems. The unit type consists of a number of small conditioning systems whereas the central type employs one conditioning system and the conditioned air is distributed. The cost of installing air conditioning in a lacquer room 75 x 20 feet, with 10 spray booths (other conditions are specified) is estimated at $22,000. Operating cost is estimated at $2.90/hr. for Carrene refrigerant and $2.15/hr. for the silical gel system. GBH (8d)

Mechanism of Chromium Deposition from the Chromic Acid Bath. CHARLES KASPER. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Sept. 27, 1935, pages 327-330; Oct. 11, 1935, pages 375-377. Slightly condensed from *Bureau of Standards Journal of Research,* Vol. 14, June 1935, pages 693-709. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 22L/4. HBG (8d)

Electroplating Industry Keeps Pace with Modernization Movement. C. W. YERGER. *Steel,* Vol. 98, Jan. 27, 1936, page 54. The recent developments in electroplating have tended to eliminate the human factor and to obtain more uniform and better plating throughout. Bright Ni and bright Zn deposits have been developed and production has been increased and improved by use of higher current densities. Bright Ni deposit needs no buffing and can be plated directly with Cr. Most marked improvement to bright Ni finish has been use of Co-Ni alloy. MS (8d)

Non-poisonous Plating Solutions (Ungiftige galvanische Bäder) K. ASSMANN. *Chemiker-Zeitung,* Vol. 59, Nov. 6, 1935, pages 904-905. Most commercial plating solutions are poisonous, and there are several advantages in having non-poisonous solutions. For Ag plating a solution containing KI, AgI, HI and gelatine and for Cu plating KI, CuI, HCl and gelatine can be used. They have good conductivity and produce fine grained deposits with good adherence. Some AgI solutions have been used commercially. Solutions of AgCNS, NaCNS and CuCNS, NH_4CNS, Na_2SO_3 have also been tried. Deposits from these baths have a fine grain and better polishing properties than those from cyanide baths. A solution suitable for undercoating on steel contains $CuSO_4$, sodium oxalate, Na_2SO_4 and $B(OH)_3$. $Ag(CS(NH_2)_3)NO_3$ has been tried, but cannot be used with high current density. No non-poisonous brass solutions have been found. Cd can be plated from $CdSO_4$ with organic addition reagents, but it has poor throwing power and coarse-grain deposits are produced. Acid Zn and Sn baths are satisfactory. Attempts are being made to develop a Cr solution without chromic acid. CEM (8d)

Concentrated Copper Cyanide Plating Baths. L. C. PAN. *Paper, Electrochemical Society,* Oct. 1935, pages 243-253. Describes experiments performed to determine optimum concentrations of Cu free cyanide, and carbonate. The following formula is offered as best so far: Cu cyanide 12, NaCN 14.1, Na_2CO_3 10.4 ozs./gal. Temperature 22° C., current density 18.5 amps./ft.^{2} Cathode efficiency is 95%, anode efficiency 75.5%. Throwing power is 47.4% and rate of deposition is 2.25 g./amp. hr. The corresponding figures for an acid Cu solution are 9 to 10% and 1.16 g./amp. hr. See also *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 454L/10. GBH (8d)

Six Years of Observation of Chromium in a Job Shop. WILLIAM A. VIGNOS. *Platers' Guide,* Vol. 32, Jan. 1936, pages 11-14. The deposition of Ni subcoat should be controlled as regards Cl, acidity, and metal content, with temperature and current density having some bearing on the type of deposits. Arrangement of the work in regard to the anodes is important. The coating produced during the first few seconds determines the character of the final Cr plate. The effects of size and shape of anodes, SO_4 content, trivalent Cr, and of Fe are briefly touched upon. WHB (8d)

Nickel and Chromium Plating of Zinc Objects (Das Vernickel und Verchromen von Zinkgegenständen). FRITZ SCHÄFER. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Nov. 1, 1935, pages 459-460. White coloration on Zn surfaces can be removed with a mixture of 1000 cc. H_2O, 15 cc. chromic acid, 5 cc. H_2SO_4 in 3-5 min. Cr or Ni plating prevent this defect *a priori.* The treatment of Zn surface prior to electro-plating is fully described. Cu or preferably brass intermediary layers are indispensable in the case of Ni plating. Zn die-castings are preferably polished in a drum containing steel balls and polishing agents. EF (8d)

Some Further Principles of Electrochemistry Applied to Electrodeposition. V. Mixed Electrolytes. VI. Coulometers. SAMUEL FIELD. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, Jan. 18, 1935, pages 103-104; Feb. 15, 1935, pages 199-200. There is seldom only one conducting constituent in an electroplating bath. Generally a supplementary conducting compound is added to reduce electrical resistance and facilitate current flow. In this article changes in conductance by the mixing of 2 electrolytes, various combinations of $CuSO_4$ and H_2SO_4, are considered. It is pointed out that in electroplating practice advantage is taken of the fact that the addition of a good conducting substance to the bath not only increases the total conductance but also reduces the degree of dissociation of the poorly conducting substance present e.g., the addition of Na_2SO_4 to a solution for Ni-plating Zn-base die castings. One advantage of this is that the preliminary coating with Cu in a cyanide bath is eliminated. Throwing power is usually increased by a scarcity of metal ions e.g., the almost negligibly small proportion of Cu ions in Cu cyanide. Measurement of current used in electrodeposition is important but since the accuracy of ammeters or other forms of electromagnetic instruments may be questioned, a method is desired that (1) accurately records steady currents and (2) accurately averages a varying current. Certain types of electrolytic cells will do this. The essential requirements of coulometers are (1) the translation of every coulomb into the desired product; (2) the products must be capable of quantitative collection and measurement; and (3) if the products are solid, they should have a large equivalent mass. Other relevant conditions are (a) ease of manipulation, (b) relative costs, and (c) availability of sufficiently pure materials. The mechanism of gas, Cu and Ag coulometers are discussed with their advantages and limitations. The Ag coulometer is used for the most accurate work. Other coulometers that have practical applications use Pb and Hg. HBG (8d)

Methods of Suspension in Electrodeposition Practice. C. F. J. FRANCIS-CARTER & B. J. R. EVANS. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, Feb. 1, 1935, pages 153-154. Abstract of paper read before the Electrodepositors' Technical Society on Jan. 16, 1935. See *Metals & Alloys,* Vol. 6, June 1935, page MA 238R/1. HBG (8d)

Cr and Cd Plating (Chromage et Cadmiage). J. LOISEAU. *Métaux,* Vol. 9, Oct. 1934, pages 560-564. Cr plating solution consists of 300 g./l. chromic acid and 3 g./l. H_2SO_4, temperature maintained at 45° C. with a current density of 10 amps./dm.^{2} The ratio H_2SO_4 to CrO_3 is maintained at 1 to 100. The bright deposit is obtained with a ratio $\frac{1}{100}$ to $\frac{1}{200}$ $\frac{H_2SO_4}{CrO_3}$. The Cd bath consists of Cd cyanide and Na cyanide to produce the combined cyanide, $Cd(CN)_2NaCN$ and free cyanide. Cd content varies between 15-20 g./l. and free cyanide 10 to 30 g./l. The following proportions are used: NaCN 49 g./l.; $Cd(CN)_2$ 41 g./l.; and NaOH 20 g./l. with a current density of 1.5 to 2 amps./dm.^{2} GTM (8d)

Cathode Film Produced During Electrolysis of Solutions Containing CrO_4 (Der Kathodenfilm bei der Elektrolyse CrO_4-haltiger Lösungen). ERICH MÜLLER & WILHELM STEIN. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 172, Mar. 1935, pages 348-352. An invisible film preventing reduction during electrolysis of oxidation products, forms on Au and Pt upon cathodic polarization in a bichromate solution, on less noble metals, such as Ag, Cu, brass, upon mere immersion in the solution. Its existence is demonstrated by the fact that it prevents proper adhesion of Ag electrodeposited from a cyanide solution on a metal which has been treated as above. Its composition seems to differ with the method of production, and it is dissolved by various acids at different rates. ORS (8d)

8e. Metallic Coatings other than Electroplating

Recent Calorizing Research. J. B. NEALEY. *Heat Treating & Forging,* Vol. 21, Oct. 1935, pages 483-484. **Calorizing Process Is Improved.** *Iron Age,* Vol. 136, Oct. 24, 1935, pages 28-29. Improved process of calorizing eliminates flaking as the coating produced is a very tough Fe-Al alloy. So effective is the process that steel may be completely converted to Fe-Al alloy if desired. MS + VSP (8e)

Aluminum Coated Iron (Feuerveraluminiertes Eisen). A. VON ZEERLEDER. *Aluminium,* Vol. 17, Sept. 1935, pages 483-487. Iron can be coated with Al by immersion in molten Al similarly to hot-galvanizing or hot-tinning. The various methods of coating Fe with Al (calorizing, alumetizing, welded-on coatings) still offer some difficulties and require absolutely clean surfaces. They are, therefore, economically not quite satisfactory. "Hot-aluminating," i.e. hot-dipping, is practiced today mainly according to the patents of Dellgren (Swiss patent 1665061), of C. G. Fink, and of Rodriguez (French patent 760,374). The metal is treated by metal chlorides or hot gases before it is immersed in molten Al. Hot-aluminated wire has been successfully employed in place of Cr-Ni wires as heating elements up to 900° C. As Al is non-toxic the material can be used safely in the food industry (canning). Such material can also be treated like Al by the eloxal process (anodic oxidation) which still further improves the corrosion resistance. Ha (8e)

Here and There with Metallizing. L. E. KUNKLER. *Metallizer,* Vol. 3, Aug. 15, 1935, page 10. Metal spraying in the architectural stone industry is practicable and is being used extensively by a few companies. Stone and concrete novelties, such as book ends, plaques, etc., can be sprayed with bronze or other metals to give the appearance of solid metal. Decorative metal spraying is being successfully applied to building fronts. BWG (8e)

The Manufacture of Aluminum Plate. HAROLD SILMAN. *Metal Industry,* London, Vol. 46, Mar. 29, 1935, page 358. Brief description of different methods of producing Al plated sheet Fe. These are the dipping process, the calorizing process, spraying and rolling processes. Relative advantages and shortcomings of the different processes are indicated. HBG (8e)

Hardness of Sprayed Metal Coatings (Die Härte gespritzter Metallschichten). KESSNER & EVERTS. *Zeitschrift für Metallkunde,* Vol. 27, May 1935, pages 104-107; abstract, *Metal Industry,* London, Vol. 46, June 28, 1935, page 700. Discusses sprayed coatings of Zn, steel, V2A, Cu, Al, and Monel, with emphasis on the first three. The effects of temperature on the base material, working distance of sprayer, gas pressure, character of spray atmosphere, feeding speed, and rate of coverage upon structure, scratch hardness, and Brinell number are discussed and optimum conditions given. GD + HBG (8e)

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5-36

8f. Non-Metallic Coatings

Coloring Metals (Über Metallfärbungen) H. KRAUSE. *Metallwirtschaft,* Vol. 14, Dec. 13, 1935, pages 1015-1017. Cd can be colored black by dipping in cold solution of 60 g. $KClO_3$, 35-40 g. $Cu(NO_3)_2$, 1 l. H_2O, brushing, redipping, rinsing, drying, and polishing. Another solution for the same purpose contains 30 g. $Cu(NO_3)_2$, 2.5 g. $KMnO_4$, 1 l. H_2O, used at 60°-80° C. Cd is colored brown in a solution containing 160 g. $KMnO_4$, 60-250 g. $Cd(NO_3)_2$, 1 l. H_2O. Cu and Cu alloys are colored brown by repeated dipping in a hot solution of 5 g. $KMnO_4$, 50 g. $CuSO_4$, 1 l. H_2O, and brushing. Addition of a little $FeSO_4$ produces a greenish color. A solution of 50-60 g. $KClO_3$, 100-125 g. $CuSO_4$ or $Cu(NO_3)_2$, 1 l. H_2O colors Cu and its alloys a reddish brown. Various shades can be produced by addition of Ni or Fe salts. Cu is colored red by dipping in molten KNO_2 or $NaNO_2$. A violet color is obtained by adding 1% $KMnO_4$. Fe is colored black by a mixture of molten $NaNO_3$ and $NaNO_2$. Addition of 5-25% NaOH produces a flat black. For some purposes it is better to color Fe in a solution of 1.5% g. NaOH, 25-50 g. $NaNO_3$, 5 g. tannic acid, 1 l. H_2O at about 160°. Al is colored gray by electrolysis in a bath of 100 g. As_2O_3, 30 g. Na_2CO_3, 10 g. KCN, 1 l. H_2O, and black by 10-20 g. $(NH_4)_2MoO_4$, 5-15 g. NH_4Cl, 1 l. H_2O. The latter can also be used for Zn, Fe, Pb, Sn and Cd. CEM (8f)

Metal Coloring with Molybdate Solutions (Metallfärbungen mit Molybdatlösungen) H. KRAUSE. *Metallwaren Industrie & Galvano Technik,* Vol. 33, May 15, 1935, pages 209-212. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 365R/7. EF (8f)

Coloring of Iron in Sodium Hydroxide Containing Oxidizing Agents (Färbung von Eisen in Natronlauge mit Oxydationsmitteln) H. KRAUSE. *Metallwaren Industrie & Galvano Technik,* Vol. 33, Sept. 15, 1935, pages 393-394; Oct. 15, 1935, pages 433-435. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 455R/6. EF (8f)

Cement Lining of Large Diameter Mains in Place by a Centrifugal Machine ELSON T. KILLAM. *Journal American Water Works Association,* Vol. 27 Aug. 1935, pages 1065-1072. Description of the cement lining of mains 48" diam. or larger by a traveling centrifugal machine. VVK (8f)

Concrete Coating for Pipe and the Wilson Machine. STERLING C. LINES. *Journal American Water Works Association,* Vol. 27, Dec. 1935, pages 1694-1698. Description of the Wilson machine which extrudes a cement coating on the pipe. VVK (8f)

Conditions Governing the Formation of Highly Insulating Anodic Layers on Aluminum. J. E. LILIENFELD, J. K. NIEH & S. GOLDMAN. *Paper, Electrochemical Society,* Oct. 1935, pages 67-80. Authors' abstract: "It is shown that for any given electrolyte there is a critical current density at the Al anode above which formation of the anode takes place. The value of this critical current density, called by us the minimum formation current, is independent of the voltage to which the anode has already been formed. Experiments were made with pure alkali hydroxide forming solutions, and also with alkali hydroxide solutions in which the hydroxyl ion concentrations were reduced by the addition of weak acids. In every case it was found that the hydroxyl ion concentration of the forming solution was the most important factor controlling the magnitude of the formation current.—." GBH (8f)

Rustproofing and Paint Adherence Technique Analyzed. F. P. SPRUANCE. *S. A. E. Journal,* Vol. 37, Dec. 1935, pages 459-464. Porosity of paint surface is favorable to electrolytic action of moisture on exposed pinhole areas. Therefore the problem of rustproofing in automotive field resolves itself into the prevention of the failure of the paint film. Since porosity of the organic coatings is unavoidable the only method of preventing the destruction of the decorative finish by peeling and cracking due to rusting of the underlying metal, is to treat the metal surface. A good rustproofing coating must possess ductility equal to that of the steel base and proper surface to give good bond with the paint. Various treatments of the steel surface are described; dioxidine treatment being one of the earlier processes for removing all traces of grease, oil, etc., from the steel and coating the surface with a mixture of phosphoric acid and oil solvent. Bonderite, spray-bonderite, electro-granodine, zinc granodine, oxalate, cromodine are the other methods. The Bonderite method is a dip in boiling Mn dihydrogen phosphate containing a small amount of Cu phosphate. It is not itself considered a rust preventer but allows greater thickness of paint film because of deposited phosphate coating on etched metal surface. In the spray-bonderite method, the most recent method of protection, sprays of the Zn phosphate are used after a degreasing cleansing of steel surface; after rinsing in plain water, a hot water-chromic acid rinse is used. Electrogranodine method gives a coating of Zn phosphate by electrolysis with a.c. in Zn phosphate electrolyte. After the steel has been degreased and cleaned, formation of coating takes place in about 3 min. with 35 amps./ft.^{2} of surface. This coating is claimed to be as rust resistant as electrolytically deposited Zn but with the advantage over the latter in that it allows perfect adherence to the paint. Zn granodine method consists of first plating thin Cd or Zn coating then forming Cd or Zn phosphate on the surface of this plate by a process as yet not described. This protective coating has greater ductility than is possible with other methods cited. Oxalate process which uses oxalic acid and Fe oxalate, gives non-resistant non-adherent, brittle coating. Cromodine method may be carried out by dipping or spraying, the solutions used being as yet unspecified, but the product is claimed to be a thin film of Fe chromate. Photographs are shown of test panels of different paints on steel samples prepared by the various methods. WB (8f)

Imitation Wood Finishes on Metal. *Steel,* Vol. 98, Jan. 20, 1936, pages 32-33. In the application, sandblasting is recommended as most suitable surface preparation. Fairly heavy baking synthetic is best for primer. For better grade finishes, baked primer should be sandpapered prior to application of color coat. Latter matches wood finish desired. Grain is then transferred from Zn plates in flat-bed lithographic presses. Heavy coating of clear lacquer is then applied and rubbed to a uniformly dull finish. In many cases it is advisable to fabricate parts first and then apply entire finish a rubber hand roller being used to apply graining ink. All materials except grain are applied by spraying. MS (8f)

Applying Cement Mortar Lining to Existing Mains in England. THOMAS H. WIGGIN. *Journal American Water Works Association,* Vol. 27, Aug. 1935, pages 1073-1081. Description of the Tate process of cement lining water mains *in situ* using Portland cement, Ferro-crete and Ciment-Fondu. VVK (8f)

Notes on Application of Sheet Iron Acid Resisting Enamel. W. H. NOBLE. *Enamelist,* Vol. 13, Dec. 1935, pages 8-9, 49. Acid-resisting enamel can be applied over either the wet or dry regular enamel, according to which procedure lends itself best to production methods. Preparation and methods of applying this enamel are described. Ha (8f)

Preservative Coatings for Structural Materials, Report of A.S.T.M. Committee D-1. ALLEN ROGERS, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 314-323. Progress report on specifications and of subcommittees. Of particular interest is the "**Statement on Principles of Testing Paints and Combinations of Paints on Steel Panels**" pages 322-323. VVK (8f)

Common Defects in the Vitreous Enamelling of Sheet Iron, C.R.C.A. Steel and Cast Iron. C. P. STONE. *Sheet Metal Industries,* Vol. 9, Oct. 1935, pages 633-636, 642. A paper presented at the second annual conference of the Institute of Vitreous Enamelers in London on Sept. 28. A comprehensive survey of the author's findings in practical enameling. AWM (8f)

Electron Diffraction Examination of Protective Films Deposited on Magnesium and Magnesium Alloys by the R A F Dichromate Process. H. G. HOPKINS. *Metal Industry,* London, Vol. 47, Sept. 13, 1935, page 273. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 22R/1. HBG (8f)

Rust Protection (Zeitgemässes vom Rostschutz) H. HEBBERLING. *Oberflächentechnik,* Vol. 12, Dec. 3, 1935, pages 281-282. Present views on ground coats for rust protective coatings on Fe are discussed and methods of application described. Instead of pure red lead, a mixture of red lead and barites is used with a saving in both pigment and binder (linseed oil) without sacrifice in quality. Bonderizing, parkerizing, bitumen coats and their correct application are briefly reviewed. Ha (8f)

Buick Anodizes Pistons on Production Basis. *Iron Age,* Vol. 136, Nov. 7, 1935, pages 38-39. Describes use of process at plant of Buick Motor Co. which in effect is a "deplating" operation. Instead of depositing material on the Al alloy piston, electric current in bath is reversed so as to make the piston the anode. The surface metal is converted by anodic oxidation to a hard oxide, which increased the life of piston by increasing its wear-resistance. VSP (8f)

The Duraspray Rust-Proofing Process. *Engineering,* Vol. 140, Oct. 25, 1935, page 456. This process for coating steelwork *in situ* was developed by Messrs. Duraspray, Limited, London. It consists in applying a priming coat of special red lead paint and then, before this is dry, dry-spraying on finely-divided metallic powder. This powder is made up of specially-prepared Zn dust and a certain proportion of Al. A final coat of paint is applied. LFM (8f)

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9. TESTING

The National Physical Laboratory. *Engineering,* Vol. 140, July 12, 1935, pages 43-46; Aug. 9, 1935, pages 148-150; Sept. 27, 1935, pages 343-345. Illustrated article outlining the work being carried out at the Laboratory on fatigue and corrosion fatigue and on welded joints, materials for use at high temperatures, hardness and stress-strain relationship during impact of sheet metal, alloys of Fe, special refractories, corrosion, light alloys, dental amalgams, Cu, and X-ray analysis of magnet steels and Fe-Sn alloys. LFM (9)

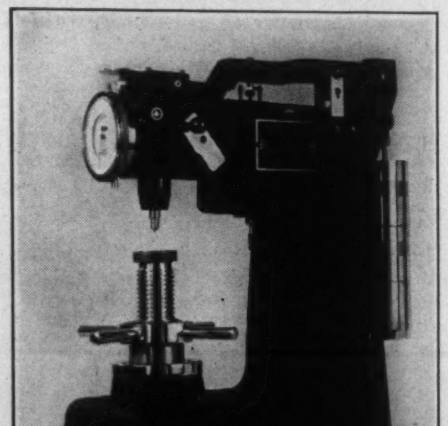
New Inspection Methods in the Manufacture of Die Castings. RENE LEONHARDT. *Metal Treatment,* Vol. 1, Winter 1935, pages 195-197, 201. Spectrographic analysis of raw materials; manufacturing control by temperature and density measurements and X-ray examination; and finished product inspection by mechanical, micrographic, and corrosion tests are discussed. Properties and compositions of typical die-casting alloys are tabulated. JCC (9)

9a. Inspection & Detects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

The Failure and Breakdown of Machinery. *Engineering,* Vol. 140, Oct. 25, 1935, pages 449-450. Editorial commenting on the recent Technical Report of the British Engine, Boiler and Electrical Insurance Company, Limited. The report considers failures due to such causes as the chemical embrittlement of boiler plates, the presence of intergranular cracks on rivets, and the introduction of welding. There seems at the present time to be a need for research on the transmission of stress-waves across the interface of welded materials. It would be helpful if fatigue tests were carried out with models of complete systems working under practical conditions. This would lead to information on the endurance limit of the machine regarded as a unit. It would be of interest to know under what circumstances the conditions of the Izod test are simulated in practice. LFM (9a)

X-Ray Exposure Charts for Steel. HERBERT R. ISENBURGER. *Transactions American Society for Metals,* Vol. 23, Sept. 1935, pages 614-620. With discussion before the New York Convention A.S.M. 1934. Previously abstracted from Preprint 22. See *Metals & Alloys,* Vol. 5, Nov. 1935, page MA 528. WLC (9a)



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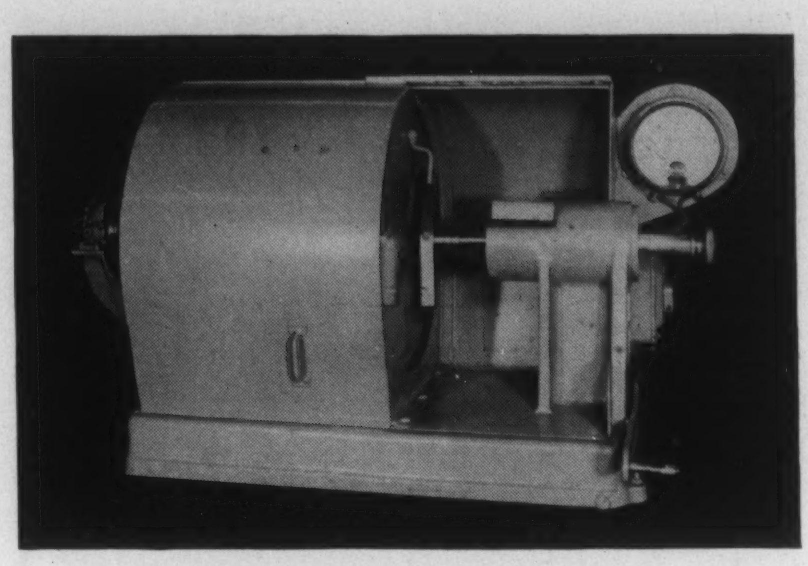

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Engineering Radiography. V. E. Pullin. G. Bell and Sons, Ltd., London, 1934. (American Agents: Engineers Book Shop, New York). Cloth, 8¼ x 11¼ inches, 136 pages. Price $16.00.

England's leading exponent of radiography has condensed into this book his experience in the interpretation of radiographs. It is written for engineers unfamiliar with the subject and consists mainly of a "de luxe" printing of some 180 radiographs. The apparatus for radiography is given a brief mention, the technique of X-ray and γ-ray radiography is discussed concisely, and a few paragraphs accompany each series of films pointing out the types of defects that are shown; but the radiographs themselves fill the most of the book and are the principal reason for its very high cost. In many cases there are sketches of the radiographed pieces and photographs of the pieces after sectioning to reveal the internal defects. The radiographs are not classified according to types of defects but according to the specimen studied: for example, the author presents in 12 pages a "Detailed Examination of Part of an Engine Column (Box Type) Steel Casting" following it with a study of another casting of the same kind that covers 20 pages and still a third that takes 10 additional pages. With such lavish printing of the films he naturally illustrates each of the defects commonly found in steel castings many times—in fact many more times than is necessary. The quality of the reproductions is excellent and cannot be criticized except by those who prefer to see them appear as "negatives" resembling the original films instead of "positives" resembling prints from the films as is done throughout this book.

The book, however, is not conveniently arranged. The numbering of prints is not consecutive throughout the book; there is no index; instead of a few sentences of explanatory matter under each photograph, the explanations are frequently to be found several pages removed from the photograph; and in the whole book there is not a single literature reference. There is little or no attempt to correlate casting practice or welding practice with the defects produced, and there is no mention of radiography of non-ferrous and non-metallic materials. C. S. Barrett (9a) -B-

Specifications for Radiographic Examinations of Steel Castings for Piping Service. Herbert R. Isenburger. *Heating, Piping & Air Conditioning,* Vol. 7, Nov. 1935, page 530. Proposed specifications given as practiced by author. WB (9a)

Examinations of Welded Seams by X-rays, Status 1935 (Untersuchungen von Schweissnähten mit Röntgenstrahlen, Stand 1935) H. Halberstadt. *Elektrowärme,* Vol. 5, Dec. 1935, pages 304-306. Curves and tables are given to determine time of exposure, distance between source of X-rays and film, and thickness of material to be irradiated. Present methods of exposing and evaluating plates are briefly described. Ha (9a)

Examination of Surface Quality of Parts for Motor Vehicles (Untersuchung der Oberflächengüte von Kraftfahrzeugteilen) A. Wallichs & G. Depiereux. *Automobiltechnische Zeitschrift,* Vol. 39, Jan. 10, 1936, pages 1-8. Determination of surface quality is of importance in parts produced in large quantities and for exchange; an objective method is necessary. Instruments have been developed which operate either optically or mechanically; the latter are sometimes connected with an acoustic apparatus which makes the surface irregularities audible (Harrison). The practical applications for manufacturing processes are discussed. 10 references. Ha (9a)

■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

The Relation Between the Tension Static and Dynamic Tests. H. C. Mann. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 323-335, discussion pages 336-340. Attempts to correlate impact test results have been unsuccessful due to the varying interpretations of data obtained from a wide variety of shapes and sizes of notched specimens. From the use of a tension form of specimen which could be tested under both static and dynamic conditions, data have been obtained which have led to the discovery of a correlation between these two types of tests. This correlation involves consideration of the fact that a material in its initial state possesses a certain amount of inherent potential energy which, during the process of deformation, is apparently converted to kinetic energy and manifested as increased elastic strength. The data indicate that the mechanism of the process of deformation and rupture is essentially the same in both static and dynamic tests. The work involved in producing deformation depends on force, time, and space, and therefore must be independent of the magnitude of the applied force. The rate of deformation for maximum energy conversion is dependent on the composition and condition of the material. The dynamic properties of a material are dependent on three major factors; volume (as determined from the length of uniform least diameter or section), velocity of the applied force, and material condition (also influenced by temperature). The present available types of impact machines are too limited with respect to velocity for determining the complete dynamic properties of materials. While the data presented concern only the tension form of test specimen, it appears entirely reasonable to assume that the theory is equally applicable to other types as well. To obtain a complete knowledge of the dynamic properties of materials, impact tests should be conducted through a range of velocities of a magnitude sufficient definitely to reveal material embrittlement. The combination of such data with that of the static test, should make possible definite predictions as to the subsequent behavior of materials under known service conditions. VVK (9b)

Notched Bar Impact Tests. G. Burns. *Metallurgist,* Dec. 1935, pages 86-88. Results of comparative Izod notched bar impact tests on Ni and Ni-Cr-Mo steels using the B.S.I. standard 10 x 10 mm. test piece and the sub-standards 10 x 5 mm. and 5 x 5 mm. test pieces showed that any attempt to convert the impact figures obtained with the smaller test pieces into the standard impact figure is subject to the possibility of a large error of the order of ± ⅓ and that, as the values given by the smaller test pieces do not rise in the same proportion as those given by the standard test piece, the subsidiary standard test pieces will not discriminate so well between tough and brittle materials as will the British standard test piece. Work on the German proposed sub-standard test piece is also reviewed. VVK (9b)

Effect of Test Conditions on Shrinkage Determination (Einfluss der Versuchsbedingungen auf das Schwindmass) O. Bauer & H. Sieglerschmidt. *Metallwirtschaft,* Vol. 14, Oct. 25, 1935, pages 854-858. The usual method for determining shrinkage was used, but the length and width of the test pieces, the rate of pouring, and the temperature of the mold were varied. The alloy was 16% Sb, .21% graphite, balance Pb. With equal width the short pieces shrank more than the long ones. With equal length the narrow pieces shrank more than the wide ones. With slow pouring rate the size of the test piece had less influence on the shrinkage than with fast pouring rate. At 20° C. mold temperature the quickly poured test pieces had higher shrinkage than the slowly poured ones, but at 130° the conditions were reversed. The results are explained by the effect of the test conditions on the average temperature of the metal in the mold which controls the shrinkage. Photomicrographs of slowly cooled and quenched test pieces showed segregation in the upper part of the mold, especially in the slowly cooled pieces. CEM (9b)

Hardness Testing of Light Metals and Alloys. R. L. Templin. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 283-304; *Metal Industry,* London, Vol. 47, Aug. 16, 1935, pages 157-160. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 25L/3. HBG (9b)

Survey of the Testing Methods for the Determination of the Mechanical Strength of Aluminum Castings (Allgemeiner Ueberblick über die Untersuchungsmethoden zur Bestimmung der Festigkeitseigenschaften von Aluminium-Gussstücken) A. von Zeerleder. *Aluminium,* Vol. 17, Nov. 1935, pages 570-574. The manner in which a specimen has been prepared for a tensile or hardness test is of utmost importance. Separately cast and cast-on specimens or taken from the casting are discussed and the tests described. The best results are obtained with horizontal casting. Ha (9b)

Special Apparatus Used for Testing Aluminium Alloys. E. John Pike. *Metallurgia,* Vol. 13, Dec. 1935, pages 35-37. Briefly describes machines for testing impact fatigue, bearing and frictional properties, and a rotating fatigue test for determining effects of casting and heat-treatment stresses in castings having abrupt changes in section. A study to determine stresses by X-ray diffraction is mentioned. Properties of some Al alloys are given to show the superiority of alloys produced by the author's firm. JLG (9b)

Measuring Surface Finishes. W. G. Myers. *Product Engineering,* Vol. 7, Jan. 1936, page 5. Size and shape of surface irregularities are measured with the "profilograph" in which a diamond tracer point moves on the surface and deflects the path of a light ray by a mirror attached to the point. Photographic records can be made. Ha (9b)

Impact Abrasion Hardness of Molded Boron Carbide and of Some Cemented Tungsten and Tantalum Carbide. L. H. Milligan & R. R. Ridgway. *Paper, Electrochemical Society,* Oct. 1935, pages 453-458. The test for hardness is performed by subjecting the polished surface of a specimen to a standardized pressure blasting, using a constant abrasive at a constant pressure. The depth of the depression produced is a measure of the hardness. In this paper it was found that for "impact abrasion" resistance molded boron carbide is approximately 15 times as suitable as crystals of boron carbide. GBH (9b)

Mechanical Testing with Small and Large Test Pieces. *Metal Treatment,* Vol. 1, Autumn 1935, pages 133-134. Annotated translation of paper by P. Chevenard in Bulletin de la Société d'Encouragement pour l'Industrie nationale, Vol. 134, 1935. JCC (9b)

Methods of Testing, Report of Committee E-1. W. H. Fulweiler, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 486-496. Progress report. **Supplement A (1935) to A.S.T.M. Manual on Presentation of Data. Presenting ± Limits of Uncertainty of an Observed Average,** pages 1411-1417. This supplement discusses the problem of presenting ± limits to indicate the uncertainty of the average of a number of observations obtained under the same essential conditions, and suggests a form of presentation for use in A.S.T.M. reports and publications where needed. **Supplement B (1935) to A.S.T.M. Manual on Presentation of Data. "Control Chart" Method of Analysis and Presentation of Data.** Pages 1418-1437. This supplement gives formulas and tables useful in applying the "control chart" method of analysis and presentation of quality data obtained from several samples. This method provides a criterion for detecting lack of statistical control of quality, which is often used for determining when observed variations in quality are greater than should be left to chance. VVK (9b)

The Effect of Cold Bending on the Elastic Properties of Heavy (3½ in. Thick) Steel Plates. C. H. Gibbons. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 275-282. This paper reports the results of a series of experiments in which test specimens were taken from various parts of a .17% C and a .27% C plate both in the cold-bent condition and in the stress-relieved condition and stress-strain determinations were carefully made on each specimen. No conclusions are drawn as the paper is intended only as a presentation of little-known data on a complex and controversial subject. VVK (9b)

A Method of Determining the Strength of Weld Metal Within a Welded Joint. *Engineer,* Vol. 160, Dec. 20, 1935, page 657. From the Technical Report for the years 1933-1934 of the British Engine, Boiler and Electrical Insurance Company, Limited. LFM (9b)

Method of Determining Distribution of Stress in Fusion-Welded Joints. *Engineer,* Vol. 160, Oct. 11, 1935, page 385. From the Technical Report for the years 1933-1934 of the British Engine, Boiler and Electrical Insurance Company, Limited. LFM (9b)

Significance of Tests on Automobile Body Sheet. J. C. Arrowsmith. *Metal Treatment,* Vol. 1, Autumn 1935, pages 117-120. Sheet steel used for die pressing inevitably lacks uniformity since it is made from "rimming" steel. Variations in composition between casts and in grain size cause varying amounts of hardening during cold rolling and influence degree of age-hardening. Apart from difficulty of obtaining representative samples, no test really measures properties which decide drawing behaviour. Tensile tests for elongation, yield point, and ultimate strength are favored as providing the most useful information. JCC (9b)

Pendulum Hardness Testing (Über Pendelhärteprüfung) W. Schmidt. *Fortschritte, der Mineralogie, Kristallographie & Petrographie,* Vol. 19, Sect. I, 1935, page 62. The reproducibility of pendulum hardness values is stressed and its utilization for mineralogical studies is recommended. EF (9b)

Hardness Conversion Chart. Clarence J. Schilling. *Steel,* Vol. 97, Sept. 23, 1935, sup. Chart for mutual conversion of hardness numbers according to Brinell, Rockwell B, Rockwell C, and scleroscope scales. Last pertains only to C, C-V, and Cr-Ni steels. MS (9b)

Bolts under Static and Impact Loads. *Engineering,* Vol. 140, July 26, 1935, pages 102-103. From a paper by H. L. Whittemore, G. W. Nusbaum & E. O. Seaquist entitled "Impact and Static Tensile Properties of Bolts" and published in the *Journal of Research of the National Bureau of Standards,* Feb. 1935. See *Metals & Alloys,* Vol. 6, July 1935, page MA 290R/2. LFM (9b)

Standardization of Resiliency Tests (Normalizacion de Ensayos-Resiliencia) J. Castells Ruiz. *Metalurgia y Construccion Mecanica,* Vol. 1, Nov. 1935, pages 13-14. Principle of the Charpy test and the machine used for it are briefly described. Ha (9b)

Optical Surface Testing of Metals, in Particular with Regard to Their Corrosion (Optische Oberflächenprüfung von Metallen, besonders hinsichtlich ihrer Korrosion) A. Karsten. *Werkstoffe & Korrosion,* Vol. 10, Dec. 10, 1935, pages 61-62. An instrument is described for determining the quality or changes of surfaces by lacquers, corrosion, paints, etc. The microscopic arrangement is rugged enough to be used in manufacturing processes by unskilled hands. Ha (9b)

A Bend Tester for Vacuum Tube Wires. W. J. Farmer. *Bell Laboratories Record,* Vol. 14, Dec. 1935, pages 139-142. A method to subject fine wires of 0.003″ to 0.125″ dia. and from 1 to 5 cm. long as used in radio tubes to bending tests is described. Ha (9b)

Stresses in Overstrained Material. *Engineer,* Vol. 160, Sept. 13, 1935, pages 270-271; *Engineering,* Vol. 140, Sept. 13, 1935, pages 281, 291-292. From a report of the Committee appointed by Section G in 1928 and read by J. G. Docherty before the British Association for the Advancement of Science, Sept. 1935. LFM (9b)

A New Method and Machine for Dynamic Hardness Testing. W. M. Patterson. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 305-322. Includes discussion. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 24R/9. (9b)

Testing of Engineering Materials. *Journal of Commerce, Shipbuilding & Engineering Edition,* Oct. 31, 1935, page 1. A discussion on the value of alternative methods of static tensile or bending tests as against fatigue tests for assessing the value of engineering materials with special reference to the testing of crane hooks, eyebolts and chain slings. JWD (9b)

180,000 kg. Compound Lever Universal Testing Machine. *Mechanical World & Engineering Record,* Vol. 98, Nov. 8, 1935, pages 449-450. The machine described tests up to 177 tons and has a space capacity of 20 x 23 x 6 ft. It is an advance in the construction of universal machines of the vertical type. WH (9b)

The "David Brown" Disc Testing Machine. *Mechanical World & Engineering Record,* Vol. 48, Dec. 6, 1935, page 550. Two discs in contact can be revolved at different speeds. The length of the line of contact can also be varied. The machine is used to determine the frictional properties of different materials and to compare the qualities of different oils under gear-tooth loading conditions. WH (9b)

Unusual Test Determines Impact Strength of Welds. *Machine Design,* Vol. 7, Dec. 1935, page 25. Describes simple but unusual means of determining the impact values of welds in the construction of oil barges. A welded 12″ box section is placed on railroad ties spaced 8 ft. apart. Then a 180 lb. weight is dropped 100 times starting from a height of 3 ft. and finishing at 75 ft. WH (9b)

New Methods for Measuring Mechanical Stresses at Higher Frequencies. A. Bloch. *Nature,* Vol. 136, Aug. 10, 1935, page 223. 2 new methods are devised for measuring stresses in impact problems or during vibrations. (1) A C coating is laid on an insulating varnish applied to the surface under examination. Changes in resistance of the C coat, as it is stressed by the underlying surface, are followed in an oscillograph. (2) A Rochelle salt crystal is cemented to the surface and the piezoelectric voltages induced by stretching or compressing it are measured in an oscillograph. CSB (9b)

Stresses in the Tyres of Locomotive Wheels. *Engineering,* Vol. 140, Oct. 25, 1935, pages 439-440. Comments on a paper by E. G. Coker & M. Salvadori issued for written discussion by the members of the Institution of Mechanical Engineers. LFM (9b)

The Testing of Engineering Materials. H. J. Gough & W. J. Clenshaw. *Transactions Institute of Marine Engineers,* Vol. 47, Nov. 1935, pages 241-267; discussion, pages 257-276. The lecture discusses certain aspects of the testing of engineering materials many of which have special interest in connection with marine engineering. Some mention is made of the method of test employed but attention is primarily given to current or recently completed researches carried out at the National Physical Laboratory. In each aspect covered, reference is made to some practical problems which appear to require further research. The subjects dealt with are: high tensile structural steels, testing of materials at high temperatures, welded joints, lubricants and bearing metals, failure of metals under complex stress distributions, fatigue and corrosion fatigue of metals, cracking of boiler plates, materials for high temperature service, contact corrosion under stress, lifting gear components and failures in service. WH (9b)

■ 9c. Fatigue Testing ■

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Fatigue Testing at the National Physical Laboratory. H. J. Gough & W. J. Clenshaw. *Mechanical World & Engineering Record,* Vol. 48, Dec. 13, 1935, pages 575-577. Describes and illustrates 2 fatigue testing machines developed at the N.P.L. for (1) testing wires and (2) testing plates. WH (9c)

Cracking of Boiler Plates. H. J. Gough & W. J. Clenshaw. *Mechanical World & Engineering Record,* Vol. 48, Dec. 6, 1935, pages 551-553. Efforts have been made to simulate boiler conditions in testing specimens but without convincing success. The latest development is a special machine for fatigue stressing a specimen while immersed in boiling solutions. WH (9c)

Fatigue Strength of Aluminum Alloys (Die Ermüdungsfestigkeit der Aluminium-Legierungen) R. Irmann. *Aluminium,* Vol. 17. Dec. 1935, pages 638-643. The usual determination of fatigue strength is made in the machine by Schenck with polished specimens. The fatigue strength is influenced by the structure of the alloy (heterogeneous or homogeneous), by the manufacturing process (casting, rolling, heat treatment), and by notch effects (due to casting skin, inclusions, segregations, oxidation). These effects are discussed individually for different Al alloys, and shown in diagrams and photographs of structures. The fatigue strength is defined as that load in kg./mm.^{2} which the material will stand under an alternating load of 100 x 10^6 alternations for Al wrought alloys, and 20 x 10^6 alternations for Al cast alloys. Ha (9c)

Some Aspects of the Fatigue Properties of Patented Steel Wires. II. Note on the Effect of Low-temperature Heat Treatment. E. T. Gill & R. Goodacre. *Engineering,* Vol. 140, Sept. 27, 1935, pages 342-343; *Iron & Coal Trades Review,* Vol. 131, Sept. 20, 1935, pages 426-428. From a paper read before the Iron & Steel Institute, Sept. 1935. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 72R/4. LFM + Ha (9c)

The Rotating-wire Arc Fatigue Machine for Testing Small-diameter Wire. J. N. Kenyon. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 156-166; *Mechanical World & Engineering Record,* Vol. 98, Aug. 8, 1935, pages 125-127. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 331L/5. WH (9c)

High-speed Fatigue Tests of Several Ferrous and Non-ferrous Metals at Low Temperatures. W. D. Boone & H. B. Wishart. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 147-155. Includes discussion. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 331L/3. (9c)

9d. Magnetic Testing

L. REID, SECTION EDITOR

On the Magnetization of Single Crystals of Nickel at Various Temperatures. Kotaro Honda, Hakar Masumoto & Yuki Shirakawa. *Science Reports Tohoku Imperial University*, Vol. 24, Nov. 1935, pages 391-410. Magnetization of single crystals of Ni were measured by the ballistic method at temperatures from —252° to 370°. At ordinary temperatures the magnetization in the direction of the (111) axis was found to rise rapidly, then more slowly as the field increased until saturation values were reached. Magnetization curves in the direction of the (110) and (100) axes were similar to those of the (111) curves but saturation values were not reached at low temperatures even in a field of 1000 oersteds. At absolute zero the saturation value of magnetization of Ni was estimated to be 523 gausses. BWG (9d)

Electro-Magnetic Tests for Work-Hardening Steel Wires. T. F. Wall. *Engineer*, Vol. 160, Sept. 13, 1935, pages 260-263. Two electro-magnetic test methods were used in this investigation of steel wires after having been in service as mine winding and haulage ropes. The ballistic magneto-striction method consists in magnetizing the wire to a known value of H and then applying a load to the wire. Induction increase due to the load is measured by the throw on a ballistic galvanometer. The tests show that the effect of work-hardening results in a relatively smaller response to large stresses. The second test method records the speed of travel and the rate of decay of a surge of stress in the wire. The method provides means for the observation of work hardening and overstrain and also measures Young's modulus in wires which are distorted in such a way that it is difficult to apply the method of longitudinal vibrations and impossible to apply the direct method of static elongation. For this test the wire must be approximately 100 ft. long. The wire is passed through 3 or 4 solenoids at equal distances along the wire and at the center of each solenoid is placed a search coil. A blow is struck at the end of the wire which is clamped at one end, to start a surge stress which then travels along the wire. As each solenoid is passed, the surge gives rise to an e. m. f. in the corresponding search coil, and this is recorded on the oscillogram. The surge decays in magnitude as it travels the length of the wire and the induced e.m.f. decays accordingly. A simple method for the calculation of Young's modulus by this means is given. A table is given comparing the figures obtained for Young's modulus by means of the traveling surge test and by the longitudinal vibration test. The materials tested include normal hard-drawn steel, annealed steel of the same composition, steel wire from a new haulage rope and steel of the same composition from a used rope, hard-drawn Armco wire, annealed Armco wire, hard-drawn pure-Ni wire and annealed pure-Ni wire. The figures show that except in the case of hard-drawn Armco wire, the value of Young's modulus measured by the traveling surge method is less than the value obtained by the longitudinal vibration test. The value for hard-drawn Ni wire is 15% greater than the value for the Ni wire in the annealed condition. Reproduction of typical oscillograms are given. LFM (9d)

9e. Spectrography

Spectrographic Determination of Impurities in Commercial Cadmium. Frances W. Lamb. *Proceedings American Society for Testing Materials*, Vol. 35, Part II, 1935, pages 71-78. A spectrographic procedure for analysis of the impurities in commercial Cd is described and illustrated by reproductions of typical analyses. A description of a simple method developed for preparing and impregnating graphite electrodes with solutions, which insures the obtaining of uniform exposures with minimum blackening of the background of the spectra, is given. The application of this procedure to the analysis of Cd-base alloys and to Cd compounds is pointed out. VVK (9e)

Quantitative Analysis of Non-Ferrous Alloys by Spectroscopic Methods. R. A. Wolfe. *Proceedings American Society for Testing Materials*, Vol. 35, Part II, 1935, pages 87-92, discussion pages 93-98. The spectrographic analysis of non-ferrous alloys, using the method devised by Duffendack, Wolfe & Smith (*Industrial & Engineering Chemistry*, Vol. 5, July 15, 1932) is described. Details are given on the determination of Al in Ni-alloys, Mg in Zn-alloys, Ba in Ni-alloys and Cr in Ni. Excitation conditions are fixed, a working curve from known standards is prepared in which is plotted the ratio of the logarithms of the relative intensities of the spectral lines against the known composition, the spectrum of the unknown sample is photographed and the logarithm of the relative intensities of the selected lines determined and then applied to the working curve giving the desired percentage. The advantages of the method are; known standards are only used once in making the working curve; analyses using only one exposure can be made; no assumptions are necessary as to the validity of the reciprocity law, the introduction of intermittency effect, or in determining exact lengths of photographed lines; the accuracy is ± 5%; a large number of elements can be analyzed at each exposure and at least 10 exposures made on a single photographic plate; analyses have been made in about 15 minutes which can probably be shortened. VVK (9e)

The Purification of Graphite Electrodes for Spectrochemical Analysis. G. W. Standen & L. Kovach, Jr. *Proceedings American Society for Testing Materials*, Vol. 35, Part II, 1935, pages 79-85, discussion page 86. The removal of metallic impurities from graphite electrodes is accomplished by the heat-treatment method or the solvent-purification method. In the heat-treatment method, electrodes which have been given a brief preliminary solvent treatment are maintained in a furnace at 1000° C. for 23 hrs. During this period the electrodes are initially saturated with dry ammonia and finally, maintained in an atmosphere of chlorine for the remainder of the run. In the solvent-purification method, the graphite electrodes are subjected to a series of solvent treatments which effectively leach out the various impurities with the exception of B and Si. Final traces of impurities are removed by burning the electrodes in an electric arc following either of the purification procedures. VVK (9e)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Relative Changes in Dimensions of Metal Wire on Annealing (Variazione relative nelle dimenzione di fili metallici per ricottura). V. Montoro. *La Metallurgia Italiana*, Vol. 27, July 1935, pages 504-507. Annealing was shown by Scarpa (*Alluminio*, 1932) to cause contraction in previously hardened Al. Several other metals have been found to have this same property, as shown by their increase in sp. gr. after annealing. Thus Al shows 0.07% increase in sp. gr.; Cu 0.00; Ni 0.19%; Fe (Armco) 0.20%; and harmonic steel 0.25% increase. The sp. gr. were measured at 27.5° C. using a pycnometer. The change in length during annealing was also measured by enclosing the wire in a steel die having a groove of the same length as the wire used (175 mm.), and provided at the end with a vernier arrangement to measure the change in length. Al and Ni show practically no change in length; Fe and brass show a slight contraction; steel expands. The changes in diam. and vol. are calculated using the equation

$$(1)\quad \frac{D}{D_o} = \sqrt{\frac{d_o}{d}} \times \frac{L_o}{L}$$

D_o and D being the diam. of the wire before and after annealing; L_o and L the relative lengths; or $(2)\quad \frac{\Delta d}{d} = -\frac{\Delta V}{V} = -\left(\frac{\Delta L}{L} + 2\frac{\Delta D}{D}\right)$

Below is a resume of the results:

			Annealing temp. °C.	Change in sp. gr.	Change in length	Change in diam. formula (2)
Al (commercial)	4	mm.	250° C.	$+0.07.10^{-2}$	$-0.01.10^{-2}$	$-0.03.10^{-2}$
	3.36	mm.	250° C.	$+0.06.10^{-2}$	-0.00	$-0.03.10^{-2}$
Cu (electrolytic)	3.36	mm.	450° C.	0.00	$+0.02.10^{-2}$	——
Fe (Armco)	2	mm.	650° C.	$+0.21.10^{-2}$	$-0.57.10^{-2}$	$+0.18.10^{-2}$
Ni (electrolytic)	3	mm.	700° C.	$+0.14.10^{-2}$	0.00	$-0.007.10^{-2}$
Brass (comm.)	4	mm.	480° C.	$+0.15.10^{-2}$	$-0.07.10^{-2}$	$-0.04.10^{-2}$
Steel (1.06% C)	3.5	mm.	650° C.	$+0.11.10^{-2}$	$+0.06.10^{-2}$	$-0.08.10^{-2}$

AWC (10)

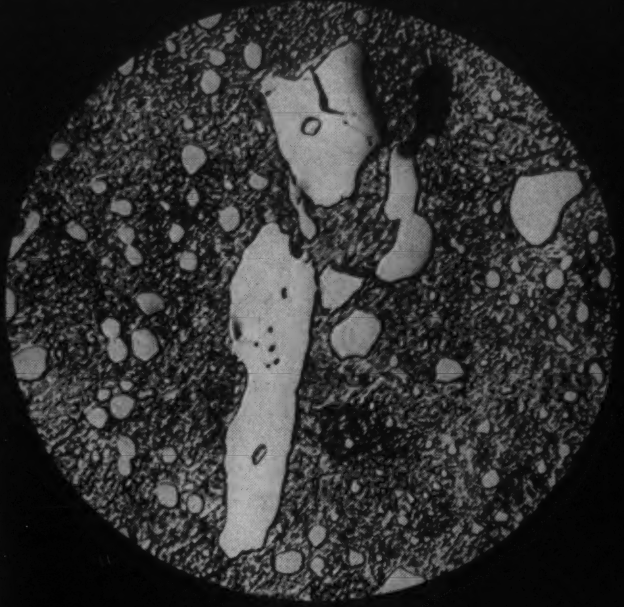
Change of Transformation Point and Microstructure of Chromium Steels Due to Cooling Conditions. T. Murakami & H. Kishimoto. *Tetsu-to-Hagane*, Vol. 20, Nov. 1934, pages 788-797. In Japanese. Utilizing magnetic analysis of specimens of less than 27.8% Cr and 1.55% C, the change of the transformation point due to the cooling conditions was studied, and several diagrams showing composition range in which the transformation is lowered and its change due to the cooling conditions were proposed. The microstructure of these specimens and its change due to the cooling conditions were examined, and structural diagrams showing the relation between the composition of specimens and the microstructures in 4 cases cooled from 900° and 1100° C. in furnace and in air, respectively, were constructed. Based on these diagrams the effects of C and Cr contents in specimens, the cooling rate and the maximum heating temperature on the microstructure were explained. By examining the microstructure of several specimens which were carburized and cooled under several conditions the effect of C on the microstructure was studied, and the correctness of the structural diagrams obtained above was confirmed. HK (10)

Small X-ray Apparatus for Fine Structure Investigations (Ein Kleinröntgenapparat für Feinstrukturuntersuchung). W. E. Schmid. *Zeitschrift für technische Physik*, Vol. 16, Apr. 1935, pages 115-119. Description of an X-ray apparatus for crystallographic investigations. Its main features are: a special water-cooled tube, 500 watts maximum, which can be operated at 30, 37, or 45 kv, with controllable tube amperage; 3 windows combined with complete electron shielding of the glass wall, permitting making 3 simultaneous exposures 35 mm. from the target; optical and acoustical signals and automatic cut-outs eliminating danger to inexperienced operators; great adaptability to various working conditions permitting convenient working in combination with X-ray goniometers, temperature chambers, and on specimens subjected to mechanical stress. See also *Metals & Alloys*, Vol. 5, Aug. 1934, page MA 412. ORS (10)

Perfect Ternary Solid Solutions. Harry Seltz. *Journal of Chemical Physics*, Vol. 3, Aug. 1935, pages 503-505. Equations are developed for calculating the solidus and liquidus surfaces with tie lines for ternary systems showing complete solid solubility, based on the assumption that both liquid and solid solution are perfect. The forms of the liquidus and solidus isotherms predicted by these equations are considered for a hypothetical example. The ternary system Au-Cu-Ni is shown to deviate markedly from ideal behavior at low mol fractions of Au, even though the Cu-Ni system is practically ideal in its binary behavior. It is pointed out, however, that the Au-Ni system shows partial miscibility in the solid state and that the Au-Cu system though completely miscible in the solid state, shows a minimum in its phase diagram. WH (10)

Amorphous Condition on Polished Surfaces of Metal. G. B. Hogaboom. *Monthly Review, American Electroplaters' Society*, Vol. 22, June 1935, pages 47-49. In answer to a discussion of existence or non-existence of an amorphous layer at metal surfaces, quotations are given from papers by Desch, Hopkins, Portevin and Cymboliste, and Lee, which were presented at a meeting of the Faraday Society, London, March 29, 1935. All conclude that the amorphous or Beilby layer exists on polished metal surfaces. GBH (10)

The Metallurgy of Low Carbon Metallic Arc Weld Metals. J. C. Hodge. *Welder*, Vol. 7, July 1935, pages 624-640; Aug. 1935, pages 654-660. The changes in chemical composition of the metal occurring during the arc transfer, the characteristic macro- and microstructures arising from the abnormal conditions in melting and casting of metal, and the variations in mechanical properties throughout a range of temperatures as affected by the before mentioned changes and by subsequent heat treatment are described, using a welding rod of 0.21% C, 0.22% Mn, 0.125% Ni. Experiments and literature are discussed. Ha (10)



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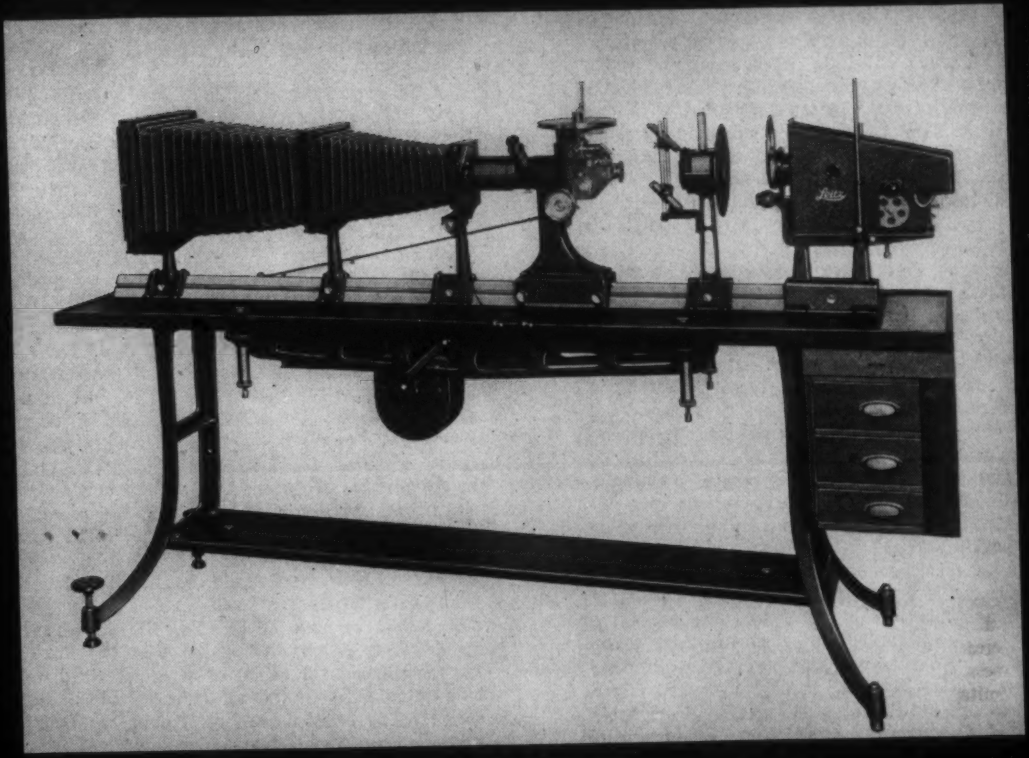

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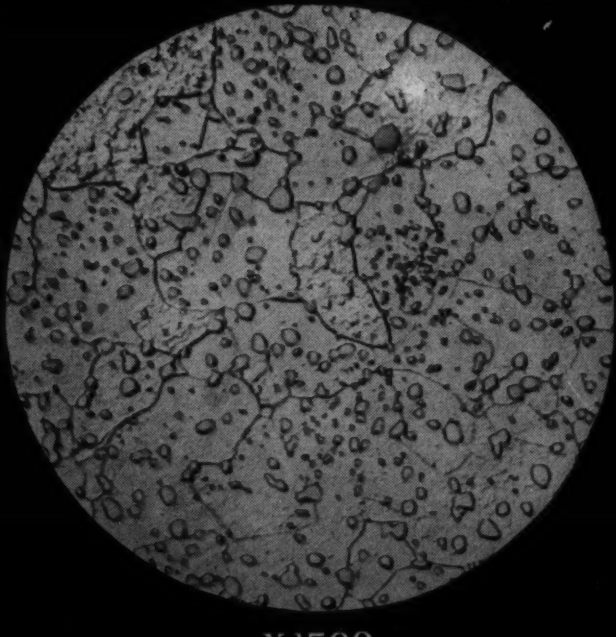

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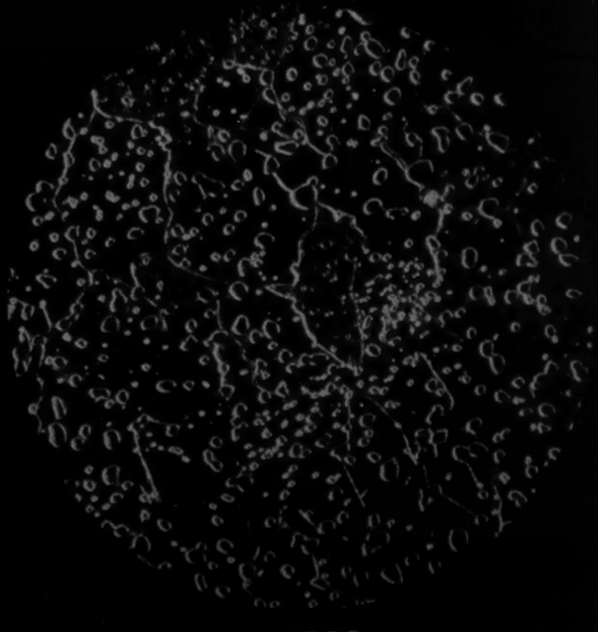

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Iron-Tantalum Binary System (Zur Kenntnis des Zweistoffsystems Eisen-Tantal). Werner Jellinghaus. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 223, Aug. 9, 1935, pages 362-364. 6 alloys were prepared with Ta metal and carbonyl Fe to 6, 10, 15, 25, 50 and 75% Ta by weight. These were prepared by sintering and then melting down in alundum crucible. Investigation of microstructure, magnetic saturation, fine structure, and diagram is reported for a range of Ta from 0 to 50 atomic %. In the 6% alloy the structure of the cooled ingots is homogeneous. When this is quenched in oil from 1200° C. there is a needle-like precipitation in the coarse-grained material. In the 10% alloy a fine network surrounds the primary grains and inside the grains there is a needle-like precipitation as in the 6% alloy. The 15% Ta has the same appearance as the 10% alloy. The max. solubility of Ta in α Fe is at the eutectic temperature between 6 and 10% Ta. The γ loop extends to a max. at about 4.25% Ta. At 25% Ta the Fe rich solid solution in dendrite form is embedded in a lamelar eutectic. The Ta content of the eutectic was determined to be between 25 and 50% Ta. The study was extended by investigating the fine structure by means of Debye-Scherrer photograms. At 15% Ta, lines other than those of Fe begin to appear, the Ta lines becoming stronger as the Ta is increased and at 75% Ta the Fe lines have disappeared. For the lattice a = 4.81 A.U. and c/a = 1.64 A.U. Calculation of elementary cell showed 158.0x 10^{-24} cm.^{3} which indicates FeTa. FeTa melts at 1700° C. WB (10)

Diffusion of Hydrogen and of Deuterium in Palladium. I (Über die Diffusion von Wasserstoff und von Deuterium in Palladium. I). W. Jost & A. Widmann. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29, Aug. 1935, pages 247-255. The diffusion constant of H in Pd determined under conditions excluding the effect of boundary reactions has been found to be: (in 10^{-5} cm.^{2} sec.$^{-1}$, at 192.5° C., —1.21; at 248.5° C., —2.43; at 302.5° C., —3.95; that of D in Pd: (same unit) at 192.5° C., —0.97; at 302.5° C., —3.01. The values are in agreement with the theory within the limits of accuracy of these experiments. ORS (10)

Contributions to the "Electrolysis" of Solid Alloys (Versuche zur "Elektrolyse" fester Legierungen). W. Jost & R. Linke. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 29, June 1935, pages 127-132. When an electric current passes through a glowing wire of an Au-Pd alloy, a transfer of Au and Pd takes place. Change of composition at the ends of the wire was determined by X-rays. The "transference number" of Pd is about 10^{-11} at 900° C. Contrary to theoretical expectations Au is transferred towards the anode, as has been also observed with Au-Pb alloys by Seith & Etzold (*Zeitschrift für Elektrochemie,* Vol. 40, 1934, pages 829-832). No theoretical interpretation of the results is attempted for lack of sufficient data. ORS (10)

Effect of Metals of the Iron Group on Precipitation Hardening of Aluminum Alloys of High Purity (Ueber den Einfluss von Metallen der Eisengruppe auf die Aushärtung von Aluminiumlegierungen hoher Reinheit). W. Koch & F. W. Nothing. *Aluminium,* Vol. 17, Oct. 1935, pages 535-546. The effect of the metals Fe, Cu, Ni, and Mo on precipitation hardening was investigated in an Al-Cu alloy with 4% Cu by taking time-hardness curves at room temperature, at 135°, and at 200° C. The results can be summarized briefly as follows (test series with Fe): Quench-hardness as well as precipitation hardness at all temperatures decreases with increasing Fe content. This is ascribed to the fact that Cu is bound by the addition of Fe and thus taken out of the solid solution. A ternary component is hereby formed, Cu_2FeAl_2. Test series with Co: Co is practically insoluble in the Al-Cu alloy with 4% Cu in solid state. It occurs as an intermetallic compound of probable composition Co_2Al_9. At 525° C. the quenching hardness shows an increase probably partly due to the hardening action of the precipitations and partly to an increase of the concentration of the solid solution by removal of Al on account of the binary compound. Additions of 0.1-0.2% Co impede the precipitations at first strongly, the increase in precipitation hardness being about the same as that of the quench hardness. Test series Ni: The view of Bingham that Al-Cu-Ni alloys do not show precipitation hardening to any pronounced degree (*Journal Institute of Metals,* 1926, page 137) does not seem to be correct, as tests with Ni up to 2% show a slowly decreasing precipitation hardening with increasing Ni content; the decrease has a certain relation to the quench hardness. The reason for the decrease is seen in the decrease of the amount of Cu available for precipitation of the solid solution, and in the formation of the ternary compound. Test series Mo: The deciding influence in Al-Cu-Mo alloys is exerted by compound $MoAl_3$ or $AlMo_4$. The increasing hardness after quenching from 360° C. is due to the hardening effect of the precipitated components. Curves show precipitation hardness maxima at different temperatures which are parallel among themselves and also to the curve of quench hardness at 525° C., except for very small additions; from this it can be concluded that both quench hardness and aging and precipitation hardness are subjected in principle to the same effects, which view was also corroborated by examination of the structures. For the ternary alloys it can be stated in general that precipitation hardening is proportional to the Cu dissolved in the solid solution. According to whether compounds are Cu-free or Cu-containing, quench and precipitation hardness will be more or less affected. 16 references. Ha (10)

Iron-cobalt-tin System (Das System Eisen-Kobalt-Zinn). W. Köster & W. Geller. *Archiv für das Eisenhüttenwesen,* Vol. 8, June 1935, pages 557-560. The ternary diagram of the system Fe-Co-Sn to 40% Sn is sketched. The boundaries of the solid phases were determined by measurements of the hardness, coercive force, loss of magnetism, and microstructure. An alloy with 19% Co and 5% Sn showed precipitation hardening. SE (10)

Isomorphism of the Ternary Compounds $Mg_3Zn_3Al_2$ and Mg_4CuAl_6 (Über die Isomorphie der ternären Verbindungen $Mg_3Zn_3Al_2$ und Mg_4CuAl_6). F. Laves, K. Löhberg & H. Witte. *Metallwirtschaft,* Vol. 14, Oct. 4, 1935, pages 793-794. $Mg_3Zn_3Al_2$ was prepared by melting the 3 metals together in the theoretical proportion and a homogeneous melt was obtained. Mg_4CuAl_6 could not be made by melting. $CuAl_2$, Al and Mg in powder form were pressed under 20,000 atm. and heated 60 hours at 500° to alloy them. Twelve alloys of various compositions were made and examined microscopically and by X-rays. Only the alloy corresponding to the formula Mg_4CuAl_6 showed only lines corresponding to a cubic lattice. $Mg_3Zn_3Al_2$ is also cubic. Both compounds contain approximately the same atomic % of Mg, 37, and correspond to the formula $Mg_{37}X_{63}$, where X may be Cu, Zn or Al. The average radius of the X atom in both compounds is about the same, 1.39 A.U. and 1.41 A.U. The lattice constant, a, for $Mg_3Zn_3Al_2$ is 14.16 A.U. and for Mg_4CuAl_6 14.25 A.U. CEM (10)

Crystal Orientations in a Nickel Casting and Their Alteration by Rolling and Recrystallization (Über die kristallitenorientierung in einem Nickelgussstück und ihre Änderung beim Walzen und bei der Rekristallisation). G. Tammann & F. Laass. *Zeitschrift für Metallkunde,* Vol. 27, Apr. 1935, pages 86-88. A 4 cm. Ni cube was cut from a casting of the same cross section and orientations determined by observation of points of maximum light reflection; cubic, dodecahedral, and octahedral types were distinguished, the last being further divided into {111} and {211} groups. Orientation distributions are determined on the casting for faces parallel and perpendicular to the cooling surface, on cold rolled samples cut from the casting, and on these specimens when recrystallized, and correlated with similar information on Al and Cu. On the castings {111} surfaces predominate near the cooling face, {100} 12 mm. from the surface, similar to Al, and indicating most rapid grain growth in [111] direction when heat dissipation is fast, in [100] direction when slow. However, Cu showed {100} orientation. Changes in orientation during rolling are the same as for Al and Cu. With increasing reductions the fraction of octahedral types increases and alignment of these in [111] direction occurs. However, up to 20% reduction Ni showed an anomalous decrease of the octahedral type and increase of cubic orientations, which cannot be explained by slip on {111} planes in the [111] direction. Samples which had been reduced 33% recrystallized at 750°, while recrystallization occurred at 650° after 90% reduction. In both cases grains were too small to permit orientation determinations until after heating to 1300° when octahedral surfaces predominated, as in Al, whereas Cu showed mainly {100}. GD (10)

Grain Growth in Carbonyl Iron and Preparation of Single Crystals of Iron (Kornwachstum im Karbonyleisen und Herstellung von Eiseneinkristallen). W. Tangerding. *Archiv für das Eisenhüttenwesen,* Vol. 9, Aug. 1935, pages 113-114. Carbonyl iron annealed at 850° C. first in air for 10 hrs. then in H_2 for 75 hrs. became very coarse grained even unicrystalline. Apparently hindrance to grain growth is greatly diminished after the last traces of C, O_2, and other impurities are eliminated in this way. Veining in this carbonyl iron appeared after more rapid cooling. The presence of veining increased the coercive force, confirming the view that veining indicates a disturbance of the α-iron lattice, accompanied by the presence of very slight traces of impurities. SE (10)

A Study of Chemical Equilibria in Melts (matte and Slag). A. N. Volsky & P. A. Agracheva. *Tzvetnuie Metallui,* Apr. 1935, pages 92-114. In Russian. 1. *Dissociation Pressure of Sulphides in Molten Slags.* On the basis of theoretical analysis of equilibrium between matte and slag the authors show the importance for theoretical metallurgy of determinations of the relation between the dissociation pressure of sulphides and oxides and their concentrations in their melts. Experimental methods developed by the authors for determination of dissociation pressures of sulphides are described. The authors determined the relation between the dissociation pressures of Ag_2S and FeS and their concentration in their solution (molten) in Cu_2S. The dissociation pressures of sulphides are shown to be considerably lowered as their concentration in the melt decreases. The mass-action constant for the reaction of dissociation of sulphides in melts does not remain constant, but is a function of concentration of these sulphides in the melt, and is decreased as the concentration decreases. 2. *Dissociation Pressure of Oxides Dissolved in Molten Slags.* The relation of dissociation pressures of FeO and its concentration in molten slags was determined. With decreasing concentration of oxide of a given metal in molten slag the equilibrium concentration of CO_2 in the mixtures of CO and CO_2 decreases. When oxides of 2 metals of different affinities for O_2 are present in slags, different concentrations of these oxides are required to produce equal dissociation pressures. The concentration is greater for the metal of greater affinity for oxygen. When this condition of equal dissociation pressures is realized both metals will be reduced simultaneously. This explains e.g., the reduction of Fe in the smelting of Cu, Pb, Ni and Sn ores in spite of the fact that certain amounts of Cu, Pb, Ni, Sn remain unreduced, although these metals possess lower affinity for oxygen than the Fe. In the oxidizing refining of metals the concentration of oxides of given metals dissolved in slag in contact with metal bath is reflected in the oxidizing action of slag on the metal bath through the decreasing dissociation pressure of oxides as their concentration in the slag decreases. BND (10)

Investigations on Differences in Lattice Constants (Die Untersuchungen zur Frage der Gitterkonstanten-Unterschiede). G. Wassermann. *Metallwirtschaft,* Vol. 14, Oct. 11, 1935, pages 813-815. A review. 13 references. CEM (10)

Type Metal Alloys. Frances D. Weaver (Mrs. Harold Heywood). *Metal Industry,* London, Vol. 46, May 31, 1935, pages 603-605; June 7, 1935, pages 625-628. An abridged form of a paper presented at the March meeting of the Institute of Metals. See *Metals & Alloys,* Vol. 6, July 1935, page MA 295L/4. HBG (10)

Investigation of the Kinetics of Precipitation of Solid Solutions of Si in Al (Untersuchung der Zerfallskinetik fester Lösungen von Silicium in Aluminium). M. I. Zacharowa. *Zeitschrift für Physik,* Vol. 96, Sept. 18, 1935, pages 754-760. In an alloy of 1.5% Si in Al, precipitation was hastened by plastic deformation. Studies of precipitation in non-deformed alloys at 218° and at 280° C. showed (1) a latent period, (2) a period of spontaneous precipitation, and (3) a period of growth or coagulation of the precipitated particles. Maximum hardness occurred at the beginning of the third period. FHC (10)

Heat of Formation of Some Sulphides (Die Bildungswärme einiger Sulfide). H. Zeumer & W. A. Roth. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 173, July 1935, pages 365-382. Heats of formation per mol at 20° C of FeS, Ag_2S, and PbS were determined to be: $\alpha Fe + \text{rhombic } S = FeS + 22.8 \pm 0.1$ kcal./FeS; $2Ag + \text{rhombic } S = Ag_2S + 6.6 \pm 0.2$ kcal./Ag_2S; $Pb + \text{rhombic } S = PbS + 23.1 \pm 0.2$ kcal./PbS. ORS (10)

A Refinement of the Heisenberg Theory of Ferro-Magnetism Applicable to Simple Cubic Crystals. Charles H. Fay. *Proceedings, National Academy of Sciences,* Vol. 21, Sept. 1935, pages 537-542. Results agreeing closely with those of the simple Heisenberg theory, but differing widely from the results of the use of the Gaussian distribution, seem to indicate that the simple approximation is better than the Gaussian. The order of validity of the simple approximation is perhaps as good as that of the other assumptions of the Heisenberg theory except at low temperatures. EF (10)

Crystals and the Polarising Microscope. N. H. Hartshorne & A. Stuart. Longmans, Green & Company, New York, 1934. Cloth, 5½ x 8¾ inches, 272 pages. Price $6.00.

The authors of this book are convinced that the polarising (or "petrographic") microscope should be widely used by chemists as a rapid means for diagnosing known compounds and for satisfactorily describing new ones, and they succeed in convincing the reader to this effect. One is inclined to believe, after reading this book, that the neglect of this tool by the average chemist is because the books that have been available up to the present on the polarising microscope have been written for the mineralogist and geologist, or, if directed at the chemist, have bristled with a multitude of details and complexities quite unnecessary for his purpose. The authors indicate that the apparatus is not elaborate and that the operations by which the optical properties of crystals are determined may be done quickly and simply. To clinch their argument for the general adoption of the method they give a summary of some fifty recent chemical researches in which the polarising microscope has been of considerable value, including, for example, the studies at the Geophysical Laboratory and the Bureau of Standards on equilibria in numerous systems of refractory oxides. As nearly all crystalline materials except metals are sufficiently transparent to be studied by transmitted light, the technique is widely applicable. The book, however, makes the field look rather too easy; a chemist cannot read the book one day and expect to go into the laboratory with it the next. If this were true, there would be little excuse for the college courses (usually graduate ones) that are customarily taken before entering the field!

The book is a manual on the symmetry and optical properties of crystals, the construction and care of polarising microscopes, and the procedure in the microscopic examination of crystals. It also includes 14 simple laboratory experiments. It is written for chemists and others who know something of the fundamentals of lenses and the phenomenon of interference, but who do not wish to consider any details of the method that are unnecessary in making chemical applications. There is no mathematics in the book; there are no tabulations of optical data of different compounds, but references are given to the best sources of this information; while no photographs of the interference figures are given, they are amply described with the aid of drawings. The book does not cover the recent metallographic studies by the reflection of polarised light from polished surfaces.

The book is to be highly recommended to those working with slags, refractories, ceramics, and various impurities in industrial materials. It will definitely help to increase the number of chemists who publish definite quantitative optical data and to decrease the number who describe the results of a crystallization in a casual way, such as "pale pink nodules" or "tufts of white flattened needles," which is of no value to subsequent observers who crystallize under somewhat different conditions. C. S. Barrett (10) -B-

Magnetism and the Electronic State of Metallic Solid Solutions and Elements (Magnetismus und Elektronenzustand Metallischer Mischkristalle und Elemente). U. Dehlinger. *Zeitschrift für Elektrochemie,* Vol. 41, Sept. 1935, pages 657-659. It is found that the theoretical magneton-composition curves for Ni-Co, Ni-Fe and Co-Fe solid solutions fall above the experimental curves. The theoretical curve is based on the assumption that each atom has given one *s* electron to the electron gas. This does not change the magnetic moment of the resulting atomic shell. The magnetic moments of Ni, Co and Fe then will be respectively 1, 2 and 3 Bohr magnetons. The difference between the curves for Fe, Ni and Co is independent of the nature of the atomic shells and must therefore be dependent upon the electron gas. It may be concluded that in ferromagnetic and temperature-dependent paramagnetic metals and alloys the *s* electron gas is not magnetically completely saturated but is partially counteracted by the spin of the atomic shells. The explanation of the magnetic behavior of metals is based on the interaction of three extinction integrals, that pertaining to the interaction of the (1) atomic shells with each other, (2) *s* electrons with each other, and (3) atomic shells with the electron gas. Fe, Ni, Co, Cu and Mn and their alloys are discussed in this connection. HAS (10)

Phase Changes During Aging of Zinc-alloy Die Castings. I—Eutectoidal Decomposition of Beta Aluminum-zinc Phase and Its Relation to Dimensional Changes in Die Castings. M. L. Fuller & R. L. Wilcox. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 338-356. See *Metals & Alloys,* Vol. 5, Dec. 1934, page MA 580. (10)

Determination of Orientations of Metallic Crystals by Means of Back-reflection Laue Photographs. Alden B. Greninger. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 61-74. Includes discussion. See *Metals & Alloys,* Vol. 6, May 1935, page MA 205R/3. (10)

Crystallographic Uniformity of Lineage Structure in Copper Single Crystals. Alden B. Greninger. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 75-88. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 296L/6. (10)

Examination of Electrodeposited Nickel Coatings by X-ray Diffraction. W. A. Wood. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Nov. 1935, supplement, pages 964-971. An X-ray diffraction examination has been made of specimens of electrodeposited Ni differing in hardness and initial brightness. The brightness was found to be associated with the degree of selective orientation of the metal grains, and the hardness with the degree of diffusion of the X-ray diffraction spectra. The diffusion of the lines is expressed in terms of fine-grain and lattice distortion, and the grain size was estimated from the broadening of the spectral lines for a series of deposits of known hardness. 6 references. Ha (10)

Transformation Points in Nickel Steels (Sur les Points de Transformation des Aciers au Nickel). Marins Sauvageot & Edmond Rousseau. *Comptes Rendus,* Vol. 201, Oct. 7, 1935, pages 611-613. Curves show transformation points obtained by the Chevenard dilatometer for a steel (C 0.62%, Ni 6%, Cr 0.5% and Mo 0.42%) heated to the Ac_3 point and cooled slowly. FHC (10)

New Laue Camera and Reflection Image Obtained Therewith (Beschreibung einer neuen Lauekamera und des dazugehöriga Reflexnetzes). Erich Schmid. *Zeitschrift für Kristallographie,* Vol. 91, July 1935, pages 95-96. The new camera is said to overcome certain shortcomings of back-reflection and rotating crystal methods. The film is placed parallel to the incident X-ray beam, which strikes the sample at an angle. An X-ray picture of Sn and its evaluation are given as an example. EF (10)

Transformation of Magnetite at Low Temperatures. Hikorok̆u Shoji. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 14, Aug. 1935, pages 679-680. In Japanese. *Scientific Papers & Abstracts Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 27, Aug. 1935, page 45. In English. Laue photographs of magnetite at room and liquid N temperature showed no evidence of transformation. WH (10)

Heats of Transformation in Iron (Untersuchungen über die Wärmetönung bei den Umwandlungen des Eisens). H. v. Steinwehr & A. Schulze. *Zeitschrift für Metallkunde,* Vol. 27, June 1935, pages 129-132. The heats of transformation at the A_2 and A_3 points of vacuum melted electrolytic iron, containing 0.03% Mn and a trace of Si, were determined by a calorimetric procedure already described. (*Zeitschrift für Metallkunde,* Vol. 26, 1934, page 130). In a series of 5 experiments the magnetic transformation was found to begin near 790° and end at 710° giving an average heat of transformation of 4.8 ± 0.02 cal./g. The change from γ to α Fe began at 894° and ended at 870°. For 6 runs the average value for the heat evolved was 6.2 ± 0.08 cal./g. GD (10)

Tetragonal Martensite in Carbon Steels. Zenji Nishiyama. *Science Reports Tohoku Imperial University,* Vol. 24, Nov. 1935, pages 517-522. To confirm the view that tetragonal or α martensite is an interstitial solid solution of C in Fe, the lattice constants were calculated from the radii of the sphere of action of Fe and C atoms. Results agreed fairly well with observed values on the change of lattice constant with C content, thus adding confirmation to the solid solution theory. BWG (10)

A Back-reflection Laue Method for Determining Crystal Orientation. Alden B. Greninger. *Zeitschrift für Kristallographie,* Vol. 91, Oct. 1935, pages 424-453. In English. See *Metals & Alloys,* Vol. 6, May 1935, page Ma 205R/3. EF (10)

Constitution and Properties of Cadmium-tin Alloys (Konstitution und Eigenschaften von Kadmium-Zinn-Legierungen). *Die Metallbörse,* Vol. 16, 1935, pages 754-755. See *Metals & Alloys,* Vol. 6, May 1935, page MA 203L/6. EF (10)

On the Theory of Superlattice Structures in Alloys. William Hume-Rothery & Herbert M. Powell. *Zeitschrift für Kristallographie,* Vol. 91, July 1935, pages 23-47. In English. After summing up the outstanding examples of observed superlattices, the Fe_3Al, FeAl, and the Cu_3Au superlattices are discussed at length and a theory of superlattice structures is set forth. EF (10)

Effect of grain Size on the Beginning of Supraconductivity (Der Einfluss der Kristallitgrösse auf den Eintritt der Supraleitung) K. Steiner & P. Grassmann. *Physikalische Zeitschrift,* Vol. 35, Aug. 1, 1935, pages 516-519. Experiments on annealed, worked, and recrystallized Sn wires showed that the transitional curve to supraconductivity is affected by grain size. **Effect of Bends on Wires on the Beginning of Supraconductivity (Über den Einfluss von Knickungen an Drähten auf den Eintritt der Supraleitung)** W. Meissner, K. Steiner & P. Grassmann. *Physikalische Zeitschrift,* Vol. 36, Aug. 1, 1935, pages 519-520. The initial part of the supraconductivity curve is shifted to lower temperatures by bends in In and Ta wires. EF (10)

The Crystal Structure of Gallium. A. J. Bradley. *Zeitschrift für Kristallographie,* Vol. 91, Sept. 1935, pages 302-316. In English. A redetermination of the structure of metallic Ga by the X-ray powder method confirmed Laue's orthorhombic structure (*Zeitschrift für Kristallographie,* Sect. A, Vol. 84, 1933, page 256) but photographs with Ni-K α radiation showed that all 3 axes were different in length: a = 4.5167 A.U.; b = 4.5107 A.U. and c = 7.6448 A.U. The axial ratios are a : b : c = 1 : 0.99868 : 1.69257. The space group is Va^{18}. EF (10)

Etching for Metallographic Investigations (Herstellung metallographischer Aetzungen für die metallographische Untersuchung) *Die Metallbörse,* Vol. 25, Aug. 14, 1935, pages 1026-1027; Aug. 17, 1935, page 1042. A useful chart gives 15 etching reagents, the composition, application, and etching effect of which are considered. Proper grinding and polishing of specimens for metallographic work are also taken up. EF (10)

X-ray Study of Aluminum Barium Alloys (Röntgenographische Untersuchung der Legierungsreihe Aluminium-Barium). K. R. Andress & E. Alberti. *Zeitschrift für Metallkunde,* Vol. 27, June 1935, pages 126-128. Alloys containing 0.5% increments of Ba from 0 to the eutectic at 2%, and 5% increments from this point to 56% Ba were studied by back-reflection powder photograms. A constant a_0 value for Al was found throughout this range, indicating no solid solution field. Only one intermetallic phase, corresponding to Al_4Ba at 56% Ba, was observed. Photograms of cleavage sections of Al_4Ba showed that it may be considered a body-centered-tetragonal lattice of Ba atoms (a = b = 4.53 A.U., c = 11.1 A.U.) whose interstices are filled with Al atoms in the positions of the two types (00u) and (0 ½ ¼), where u is 0.38. GD (10)

Structural Changes in Gray Iron Subsequent to Annealing (Variazioni strutturali nella Ghisa grigia consequenti a Ricottura). V. S. Prever. *Industria Meccanica,* Vol. 17, Nov. 1935, pages 978-982. An ordinary gray Fe was heated to different temperatures and for different lengths of time and the structural changes were observed. No typical changes can, however, he stated; the complexity of the phenomena does not permit a uniform explanation. Individual micrographic examinations are required in most casts of metallographic determination. Ha (10)

Copper-Nickel-Zinc Alloys (Kupfer-Nickel-Zink-Legierungen). J. Schramm. K. Triltsch, Würzburg, 1935. Boards, 6 x 8 inches, 129 pages. Price 4 RM. Extensive phase rule study of the Cu-Ni-Zn system with many sections of the solid diagram. H. W. Gillett (10) -B-

Influence of Structural Characteristics on the Properties of Metals. N. A. Ziegler. *Industrial Heating,* Vol. 2, Oct. 1935, pages 575-579. The physical properties of steels, in particular the structural characteristics, are determined by (1) condition of metallic grains before the heat treatment, (2) condition of metallic grains (usually austenitic) at the heat treating temperature, (3) final or ultimate grain condition. Ha (10)

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11. PROPERTIES OF METALS AND ALLOYS

Recent Developments in Metals Sealing into Glass. HOWARD SCOTT. *Journal of the Franklin Institute*, Vol. 220, Dec. 1935, pages 733-753. Co added to low expansivity Ni steels increases the temperature to which the steel can be heated and still retain the property of low expansivity. As a result, Fe-base alloys may now be sealed in hard glass. FHC (11)

Calculation of Energy Values of Metals from Recrystallization Data (Die Berechnung der Auflockerungswärme der Metalle aus Rekristallisationsdaten). J. A. M. VAN LIEMPT. *Zeitschrift für Physik*, Vol. 96, Sept. 7, 1934, pages 534-541. From recrystallization data, the following equation is derived to explain the heat energy governing the mobility of atoms grouped in a space lattice.

$$E = 4.6\ C + 1200\ \beta$$

Where E = heat governing the loosening of atoms from their space group limitations,
C = recrystallization constant, and
β = deformation gradient.

Energy relations of the loosening of atoms can also be explained on the basis of diffusion phenomena and on the elastic recovery of metallic atoms. FHC (11)

Metals—Their Structure, Characteristics and Idiosyncrasies. V. N. KRIVOBOK. *Canadian Chemistry & Metallurgy*, Vol. 20, Feb. 1936, pages 48, 50. The general application of studies of atomic arrangement is most apparent in the alloys. Alloys possess the same general atomic arrangement as the pure metals. The characteristics of alloys of Fe and C; Fe and Si; Fe, Ni and Cr, etc., are outlined. From the periodic table of elements it is possible to decide what type of diagram will be obtained with a certain alloy and thus roughly determine its utility even before manufacture. Mechanical testing methods indicate in a crude way only changes in metals, and to understand what takes place when the properties of a metal suddenly change we must resort to studies of the atomic arrangement and other exact methods of determining what is taking place. The changes in properties of metals may also be explained, on the basis of a change in the number of slip planes, with a consequent change in the ductility of the metal. WHB (11)

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Crystallization in Binary Systems with Eutectics (Ein Beitrag zur Kristallisation binärer Systeme mit Eutektikum). E. RAUB. *Zeitschrift für Metallkunde*, Vol. 27, Apr. 1935, pages 77-83. The grain size and structure in binary systems were observed by metallographic methods. It was found that these are both determined by the characteristics of the primary constituent, but are also influenced by other factors which affect pure metals, such as, size and shape of the casting, pouring temperature, and rate of cooling. Experiments have shown that the structure has little effect on the mechanical properties when the constituents have widely varying properties, but the structure is determinative when the components have similar properties. Using 83% Ag-Cu alloy as an example of the latter type it is shown that recrystallization and deformation processes are similar to those in pure metals and solid solutions, the distribution of phases having little importance. For this alloy he shows that cold rolling leads to anisotropy, as in pure metals, as does subsequent recrystallization, both effects being strongest at high reduction and high annealing temperature. Demonstrated by data on extension and tensile strength, the first shows a maximum, the latter a minimum in test foils cut 45° to rolling direction. GD (11a)

The Ductile Alloys of Copper and Silicon. H. H. PARRETT. *Metal Industry*, London, Vol. 46, Mar. 29, 1935, pages 349-350. The author describes a series of Cu-Si alloys containing 3-5% Si investigated to determine the composition giving the highest strength and ductility and the amenity of the alloys to such heavy working as the production of fine wire. His conclusions show that the alloys having 4.00-4.70% Si are ductile and have a tensile strength superior to phosphor bronze. If the Si content is above 4.70% the alloys become brittle. The Cu-Si alloys are not as resistant to sea-water corrosion as phosphor bronze. Rapid continuous annealing at as low a temperature as possible is necessary for these alloys. HBG (11a)

Embrittlement of Uranium by Small Amounts of Aluminum and Iron. H. W. HIGHRITER & W. C. LILLIENDAHL. *Transactions American Institute of Mining & Metallurgical Engineers*, Vol. 117, 1935, pages 381-386. Includes discussion. See *Metals & Alloys*, Vol. 6, Oct. 1935, page MA 411L/10. (11a)

Aluminum Alloys—Patent List (Aluminium-Legierungen, Patentsammlung) A. GRÜTZNER & G. APEL. Supplement to section on aluminum in Gmelins Handbuch der anorganischen Chemie. Verlag Chemie, Berlin, 1936. Paper, 7 x 10 inches, 342 pages. Price 35 RM.

Index, by alloy composition, of patents on Al alloys. Patents of Germany, England, France, Austria, Switzerland and the U. S. from 1887 to May 1935 are listed. The Al alloys containing Si cover 113 pages, ranging from the binary group up to Al-Si-Co-Cr-Cu-Mg-Mn-Mo-Ni-Sb. If an element is mentioned in the patent specification as being a possible addition or substitute, that element is indexed. It must have been a huge task to prepare the index, which would be a great aid in patent searches. H. W. Gillett (11a) -B-

Modulus of Elasticity for Cu-Be Alloys (Sur le Module d'Élasticité des Alliages Cuivre-Beryllium). LÉON GUILLET. *Comptes Rendus*, Vol. 201, Nov. 18, 1935, pages 960-962. Author demonstrates with graphs the increase in hardness and in the modulus of elasticity for Cu alloys with a Be content varying from 2 to 18.5% by weight. With 15% Be the alloy has a modulus equal to that of steel. FHC (11a)

Compression Requirements for Avional Samples (Knickbeanspruchung an Avional-Stäben). K. Guler. *Zeitschrift für Metallkunde,* Vol. 27, June 1935, pages 137-138. Stress-strain curves were obtained for a high quality Avional containing 0.7% Si, 0.7% Mn, 0.7% Mg, and 4% Cu. The compression elastic modulus was calculated from these and related to the shape of the specimen. The compression experiments were made on an apparatus designed to insure uniform aplication of load. GD (11a)

Experiments on the Electrical Resistance of Copper and Some Copper Alloy Wires. Clement Blazey. *Journal Institute of Metals,* Vol. 58, Nov. 1935, pages 503-522 (*Advance Copy* No. 719). Electrical resistances of 7 samples of high-conductivity Cu, a furnace-refined Cu, 2 Cu-Cd alloys, and some specially prepared samples were measured after annealing in CO_2 at temperatures over the range 300-950°C. One series of samples was quenched from the annealing temperature and another was slowly cooled. In general, a minimum resistance resulted from annealing at 500°C. and the resistance gradually increased as the annealing temperature was increased above this temperature. The increase, however, tended to disappear when the wires were slowly cooled from the annealing temperature or when the wires were reheated to 500°C. In wire-bar Cu the increase in resistance on quenching from 950°C. varied from 0.5 to 1%. Additions of S and Se to Cu increased resistance increase brought about by quenching from a high temperature. Causes for increase in resistance are discussed. The most probable cause is the increased solubility of some element present in all the Cu examined—possibly O. JLG (11a)

The Bronzes as Engineering Materials. F. Johnstone Taylor. *Metal Industry,* London, Vol. 46, Apr. 26, 1935, pages 453-456. The multiplicity of alloys now available has made necessary closer coöperation between metallurgist and brass-foundrymen. The variety of alloys available for various forms of fabrication are indicated. While the major purpose of casting in bronze is to resist corrosion, high strength—particularly at high temperatures—is frequently a requisite. The author discusses an 85:5 Cu-Sn (Editor's note: Probably an error) corrosion resistance bronze that is superior in many ways to gun-metal and Mn-bronze. The following data on this material are reported:

Type of Material	Ultimate Strength Tons.	Reduc. in Area, %	Elong. in 2", %	Brinell	Density
Cast	21	34	39	72	8.62
Drawn Rod	44	60	30	130-171	
Cast Material (at 1000° F.)	20				

This material is suitable for high temperature work such as pressure valves for superheated steam-lines, for use in oil lines, and for use in brewing, distilling and paper-making trades where corrosive liquids must be withstood. The variety of proprietary metals developed for certain superior physical properties are considered and the effect of variation of the major constituents and the influence of metallic additions are indicated. The advantages of certain alloys of the solid solution type, such as Everdur, their physical properties and certain commercial applications are noted. Foundry practice with emphasis on pyrometric temperature control is recommended. The author describes a method for ensuring a pressure-tight casting. Methods of casting Ni-bronze and Si-Cu are given and the importance of gating is emphasized. HBG (11a)

Vapor Pressure Abnormalities of Amalgams (Dampfdruckabnormalitäten bei kapillaraktiven Amalgamen). Hans H. von Halbon. *Helvetia Physica Acta,* Vol. 8, Feb. 15, 1935, pages 65-81. The vapor pressures of K, Na and Zn amalgams were determined by the author's method which depends on the intensity of absorption of resonance radiation by the vapor. Even when the concentration of K, Na and Zn is very low, drastic decreases of the vapor pressure of Hg were noticed. This phenomenon is attributed to surface adsorption of the metals since stirring restored almost completely the vapor pressure of pure Hg. EF (11a)

Non-Ferrous Casting Alloys of High Strength. A. J. Murphy. *Metal Industry,* London, Vol. 47, Sept. 6, 1935, pages 229-232; Sept. 27, 1935, pages 319-321; Oct. 4, 1935, pages 346-349; *Foundry Trade Journal,* Vol. 53, Oct. 10, 1935, pages 271-274; Oct. 17, 1935, pages 291-294; *Canadian Chemistry & Metallurgy,* Vol. 19, Sept. 1935, pages 245-247, 250; Oct. 1935, pages 274, 276-277. Exchange paper of the Inst. of British Foundrymen to the Annual Convention of the A.F.A. at Toronto, Can., Aug. 20-23, 1935. The author outlines a wide range of alloys which, in addition to high strength, have other desirable properties. The alloys considered include Mn-bronze, Al-bronze, Ni-alloys, Zn-alloys, Al-alloys, Ceralumin-alloys, and Mg-alloys. The physical properties of these alloys, necessary precautions to be taken, the effect of additions, applications and the relation of high strength to other properties are included in the discussion. Microstructures of some of the alloys discussed are included. WHB+AIK+HBG (11a)

Hardness of Heat-Treated Al Bronzes. I. Binary Bronzes of the Type 90- 10 (Ricerche sulla durezza di rinvenimento dei bronzi d'alluminio. I. I bronzi binari del tipo 90- 10). C. Panseri. *Alluminio,* Vol. 4, July-Aug. 1935, pages 213-217. The variation in hardness with the temperature of heat-treatment of 2 types of Al bronzes has been determined. The bronzes contained 10.85 and 10.68% Al, respectively, but type "O" had 0.26% Fe and 0.07% Si, while type "OO" had only 0.02% Fe and 0.04% Si. Samples were hardened at 900°C., and then tempered at increasing temperatures. Type "O" increases in hardness as the temperature of heat-treatment increases, up to a maximum of 400°C.; then there is a sudden drop in hardness as the temperature of heat-treatment is increased to 650°C. where it reaches a minimum, which is retained with heat-treatment, up to 900°C. Type "OO" bronze behaves similarly. The maximum hardness (Brinell, 250 kg. load, 5 mm. ball, 30 seconds time) varies from 221, when heat-treatment is carried out at 250°C., up to a maximum of 235, and then down to 164 for temperatures of 650°C. and above. For type "OO" the hardness varies from 218 to a maximum of 255 at 350°C., and down to 118 when the heat-treatment is carried out at 750°C. and above. AWC (11a)

Note on the Effect of Interrupted Straining on the Elongation of Lead. J. C. Chaston. *Engineering,* Vol. 140, Oct. 11, 1935, pages 397-398; Vol. 160, Oct. 4, 1935, page 342. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 372L/9. LFM (11a)

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Effect of Small Quantities of Bismuth and Manganese on Tin (Ueber den Einfluss kleiner Mengen von Wismut und Mangan auf Zinn). *Die Metallbörse,* Vol. 35, May 18, 1935, pages 625-626. Literature survey emphasizing recent investigations of Hanson & Sandford. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 334R/3. EF (11a)

Determination of the Melting Points of Calcium, Strontium, and Barium (Bestimmung der Schmelzpunkte von Kalzium, Strontium, und Barium). F. Hoffmann & A. Schulze. *Zeitschrift für Metallkunde,* Vol. 27, July 1935, pages 155-158; *Physikalische Zeitschrift,* Vol. 36, July 1, 1935, pages 453-458. Samples weighing about 20 g. were melted in pure Fe crucibles in oxygen-free argon within a vacuum oven. Heating and cooling curves were taken with a precious metal thermocouple and the accuracy of determination of the melting point estimated as ±1°. Three samples of technical Ca of about 95% purity gave melting points of 810°, 813°, 819° while resublimed material of 99.9% purity melted at 849°. A 99.9% commercial Sr sample melted at 756° but resublimed Sr melted at 771°. Technical Ba samples of 99.9% and 97% purity melted at 670° and 669° respectively, while 99.8% resublimed Ba melted at 704°. In all cases the differences found between technical and resublimed material are attributed to the presence of nitrides in the former. EF+GD (11a)

The Most Important Properties of Fabricated Light Metals from the Production Viewpoint (Die wichtigsten Eigenschaften der mechanisch verarbeiteten Leichtmetalle für die Betriebspraxis). H. Jensch. *Metallwaren Industrie & Galvano Technik, Sect. Werkstoffkunde & Verarbeitungstechnik,* Vol. 33, Apr. 1, 1935, pages 150-156. Tabulates and discusses physical properties of 13 important light alloys. Their behavior under corrosive conditions is briefly dealt with. EF (11a)

Dental Alloy Containing Silver as Base. Senji Hatada. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 14, Sept. 1935, pages 885-890. In Japanese. *Scientific Papers & Abstracts Institute of Physical & Chemical Research, Tokyo,* Vol. 27/28, Sept. 1935, pages 57-58. In English. Substitutes for Au, Pt and their alloys were studied chemically. The favorable physical properties of Ag are pointed out and attempts were made to overcome its main drawback, the tendency towards discoloration. A great number of binary Ag alloys were submitted to corrosion tests and an alloy containing 70% Ag and 30% Pd was found to be highly corrosion resistant and to possess excellent physical properties with respect to its use as a dental alloy. WH (11a)

A New Bearing Metal—A Lead Base Alloy. C. H. Hack. *Metal Progress,* Vol. 28, Nov. 1935, pages 61-64, 72. Describes a lead base bearing alloy hardened by Ca and other alloying elements. It has in addition to excellent bearing properties a resistance to damage by temperatures up to 560° F. WLC (11a)

Temper Hardening of Commercial Nickel-Coppers Containing Phosphorus. E. C. Rollason & T. G. Bamford. *Metals & Alloys,* Vol. 6, Dec. 1935, pages 345-346, 349. Age hardening characteristics of 3 Cu alloys of 1.72%, 1.73% and 2.33% Ni and 0.03%, 0.11% and 0.03% P respectively are reported. WLC (11a)

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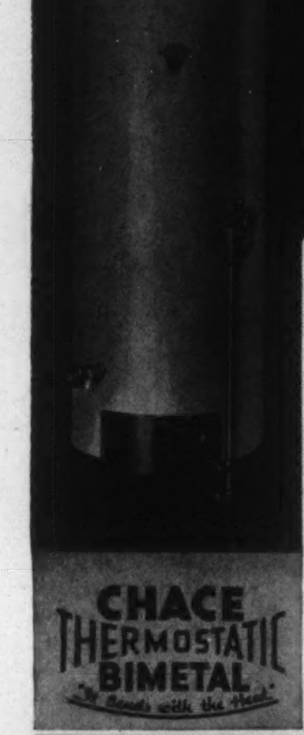

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Production, Properties and Commercial Utilization of Palladium (Herstellung, Eigenschaften und Verwertung des Palladiums). E. T. RICHARDS. *Die Metallbörse,* Vol. 25, June 29, 1935, page 819; July 6, 1935, pages 850-851; July 13, 1935, page 882; July 20, 1935, pages 914-915. Occurrence, separation from the Pt metal group, physical and chemical properties of Pd are dealt with. Pd-bearing alloys which have gained commercial importance are particularly considered. The latest advances in the electro-deposition of Pd are discussed in detail. EF (11a)

The Influence of Impurities on Some Industrial Aluminum Alloys. I. T. KOLENOV & B. F. GRASHCHENKO. *Legkie Metallui,* Vol. 4, Apr. 1935, pages 40-55. In Russian. The influence of Fe, Si, Zn, and Cu on the mechanical and corrosion resistance properties of Duralumin, Aludur, and Silumin is discussed. HWR (11a)

Brass and Other Copper Alloy Wire and Wire Products. Published by Copper Development Association, London, 1935. Boards, 4 x 7 inches, 50 pages.

This was issued as C.D.A. publication No. 16 and covers the mechanical properties and other data for copper alloy wire, together with examples of applications. Richard Rimbach (11a) -B-

Copper and Copper Alloys, Cast and Wrought, Report of Committee B-5. C. H. MATHEWSON, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 179-180. 3 new tentative specifications are presented: for Cu-Si alloy wire for general purposes; for wrought phosphor-bronze bearings and expansion plates for bridges and structures; and for wrought silicon-bronze bearings and expansion plates for bridges and structures. VVK (11a)

Non-Ferrous Metals and Alloys. Report of Committee B-2. R. F. MEHL, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 136-140. Progress report primarily on specifications. VVK (11a)

A Discussion of the Transition Metals on the Basis of Quantum Mechanics. N. F. MOTT. *Proceedings Physical Society,* Vol. 47, July 1935, pages 571-588. Magnetic and electrical properties of Co, Ni, Pd, and their alloys with Cu, Ag, Au are discussed on the basis of quantum mechanics. The relative high resistance of the transition metals can be explained. The number of electrons in the outermost state must be 0.6 per atom in transition metals and 1 in noble metals. 32 references. JCC (11a)

Standardization of Aluminum Alloys. (Die Normung der Aluminiumlegierungen). W. KOOPMAN. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Nov. 30, 1935, pages 1445-1446. The basic considerations for a standardization of Al alloys are explained as they are applied in the German standard DIN 1713. Conditions of the metal as delivered, hardened or cold deformed, possibilities and manners of welding, corrosion resistance and purpose of application have been taken into account. Ha (11a)

Zinc (Zink) German Committee on Standards for Non-Ferrous Metals. *Zeitschrift für Metallkunde,* Vol. 27, Aug. 1935, page 191. Analytical requirements are set down for different classes of commercial Zn. GD (11a)

The Physical Properties and Annealing Characteristics of Standard Nickel Silver Alloys. MAURICE COOK. *Journal Institute of Metals,* Vol. 58, Dec. 1935, pages 551-565 (Advance Copy No. 721). A series of alloys containing approximately 63% Cu, from 10 to 30% Ni, and the balance Zn were melted and cast into ingots 1⅝″ thick. Ingots were rolled to 0.30″ by a sequence of rolling and annealing. These strips were then rolled to 0.031″, samples being taken at stages of 10% reduction in thickness. Mechanical properties and change in properties on annealing were then determined for the material given different reductions. The modulus of elasticity increased progressively with Ni content, and in annealed condition hardness also increased with Ni content. The difference in hardness was not maintained when the materials were cold rolled, the hardness increase decreasing as the Ni content increased. The temperature at which softening begins on annealing increases with Ni content. Density, electric conductivity, thermal conductivity, and thermal expansion of the alloys were also determined. 29 references. JLG (11a)

Softening and Recrystallization of Pure Aluminum. (Ueber die Erweichung und Rekristallisation von reinem Aluminium). *Aluminium,* Vol. 17, Nov. 1935, pages 575-576. The experiments of Calvet to determine the effect of impurities on the velocity of softening are discussed. The velocity depends to a large degree on the purity of Al. The recrystallization velocity is very high for the very pure metal and increases rapidly with increasing temperature. Ha (11a)

Beryllium. *Metallurgist,* Dec. 1935, pages 91-93. A review of the production, properties and applications of Be and Be alloys. VVK (11a)

A New Low-Melting Alloy. SIDNEY J. FRENCH. *Industrial & Engineering Chemistry,* Vol. 27, Dec. 1935, pages 1464-1465. The new alloy consists of "Lipowitz eutectic alloy" plus indium, and has a m. p. of 46.5° C. Some possible applications of the alloy are suggested, and cooling curves are shown. MEH (11a)

Melting Points of Eutectics. Lipowitz Alloy and Wood's Metal. SIDNEY J. FRENCH. *Industrial & Engineering Chemistry,* Vol. 28, Jan. 1936, pages 111-113. The author gives the compositions of the 2 alloys, and the melting range is given as 69.7°-71.7° C. for both. It is thought that the abnormally low m.p.'s reported in the literature may be those of undercooled alloys or amalgams, and the author suggests the name "quaternary eutectic" with a designation of its composition and melting range, in place of the older, confusing names. MEH (11a)

Copper Wire, Report of Committee B-1. J. A. CAPP, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 133-135. Progress report on specifications. VVK (11a)

Properties of Silumin Containing Magnesium (Die Eigenschaften von magnesiumhaltigem Silumin (Silumin Gamma)) G. SACHS & E. SCHEUER. *Metallwirtschaft,* Vol. 14, Nov. 22, 1935, pages 937-941; Nov. 29, 1935, pages 972-975. This alloy, containing 12% Si, .4% Mg, .5% Mn, balance Al, is especially suitable for large and complicated castings which require high strength. Large castings can be quenched in water during heat treating without danger of cracking. Slight warping can be overcome by straighening after quenching, but after aging this alloy is too stiff to straighten. It was found that in castings quenched under ordinary conditions the hardness of thin sections was less than that of heavy sections. This was due to cooling of the thin sections during the transfer from furnace to quench. Uniform results were obtained when this interval was reduced to 10 seconds by improved equipment. It is essential to use cold water for quenching and the highest possible temperature, usually 525° C. after 3 hours heating. At about 550° the Al-Si-Mg_2Si eutectic melts and leaves voids at the grain boundaries. Very large castings are apt to be too soft due to the relatively large interval between Mg_2Si dendrites and resulting slow diffusion. This is overcome by increasing the heating time and by the use of chills. The use of salt as a flux should be avoided as it lowers the Mg content and results in low physical properties. The aging treatment is not critical, 20 hours are required at 150° and 4 hours at 180°. The endurance limit is quite high in the quenched state, but is not increased by aging. It is not lowered by running water over the test piece. Test bars cut from 14 production castings averaged 31.3 kg./mm.^{2} tensile strength, 2% elongation, 109 Brinell hardness, and 7 kg./mm.^{2} endurance limit. Still better properties are obtained in permanent mold castings. Silumin gamma is not recommended for castings which are subjected continuously to temperatures higher than 150° to 170°. 12 references. CEM (11a)

Electrical Resistance Alloys. F. P. PETERS. *Paper, Electrochemical Society,* Oct. 1935, pages 351-362. A resistance alloy should have the following properties: (1) High resistance, (2) low temperature coefficient of resistivity, (3) resistance to oxidation, (4) high melting point, (5) strength at high temperatures, (6) reasonable cost. The 80-20 Ni-Cr alloys fill these requirements. Some other alloys containing Fe-Cr-Al and Fe-Cr-Al-Co exceed 80-20 Ni-Cr have higher resistivity and better resistance to oxidation but they exhibit a permanent increase in length characteristic, lack of strength at high temperature and are difficult to fabricate. GBH (11a)

Magnesium Alloy Developed for Die-Cast Products. J. B. NEALEY. *Steel,* Vol. 98, Jan. 20, 1936, pages 29-30. Dowmetal can be produced in almost every known form. It can be die cast successfully by the press-cast process. Dies used are similar to those used in die casting Al. However, larger fillets and rounding of sharp corners are often advantageous. Most commonly used die-casting alloy is Dowmetal G, which contains 89.9% Mg, 10.0% Al, and 0.1% Mn. It combines good casting properties with good mechanical properties. Forgings are employed where higher strength and impact properties are required than can be obtained with die castings. Press forgings are recommended in preference to hammer forgings because of greater time available for metal flow. Existing dies and equipment can be easily adapted. Where maximum strength is desired and forged part is not too intricate, Dowmetal alloys F(95.7% Mg, 4.0% Al, 0.3% Mn), J, and A(91.8% Mg, 8.0% Al, 0.2% Mn) generally are used in the order named. For moderately stressed parts subject to salt H_2O conditions M(98.5% Mg, 1.5% Mn) is used. Extruded bars and rods are used for forging stock instead of cast billets as they permit wider forging temperature range and greater speed of forging. Forging temperature ranges from 600° to 825° F. and 1 hr. at heat for each in. thickness should be allowed. Heat treatment is unnecessary as forging develops maximum strength. Tabulates physical properties of the various alloys and mechanical properties of cast alloys. MS (11a)

Study of Iron-carbon-aluminum Alloys. B. E. Somin, N. N. Lipchin & Yu. M. Margolin. *Kachestvennaya Stal,* No. 9, 1935, pages 22-37. In Russian. Specimens were prepared in high frequency induction furnace and contained 0.05 to 1.2% C and 4 to 16% Al in steps of 2%. All could be forged between 1000° and 1200° C. All samples were quenched at 1050° C. in oil, drawn 40 hours at 450° C. and finally annealed at 1100° for one hour and furnace cooled. At each stage of treatment specimens were studied for their structure, hardness, electrical resistance and magnetic properties. On most of them Curie point was determined. 4 and 6% Al alloys showed decrease of pearlite in annealed, and of martensite in quenched steels having the same C content with the rise of Al. Al shifts the pearlitic point to the right at the rate of 0.087% C for each % of Al. At 8% Al pearlite does not form any more and C is precipitated as η phase of F. R. Morral, *Journal Iron & Steel Institute,* 1934, throughout the grains. With higher C contents it is present as massive inclusions, but when C is removed, as on the outside of specimens, their shape approaches needles, either separately located or crossing each other. This is explained on the basis of anisotropic speed of crystallization of this substance. η phase reduces grain size causing gradual refining of the fracture with increasing C. Data of Keil & Jungwirth, *Archiv fuer Eisenhuettenwesen,* Vol. 4, 1931, page 221, on the complete lack of graphitization between 10 and 18% Al are fully supported. C is tied here in η phase, which is quite stable. The amount of it with the same C passes through a maximum at 12% Al and a minimum at 14% Al. C concentration in η phase is lowest at 12% and greatest at 14% Al corresponding to Fe_3Al. Electrical resistance shows anomalies both for high and low C steels due to the formation of superlattice. Quenching speed for low C was not high enough because with about 14% Al crystals passed from random orientation, at least partially. With sufficiently long drawing at low temperature, arrangement of the crystallites begins with 4% Al and depends, apparently, on the closeness of the composition to the stoichiometrical ratio, to 14% Al in this case. Degree of freedom from random orientation is greater after drawing than after annealing. Increasing Al content lowers magnetic induction both in quenched and drawn alloys. Higher C samples show a break at 8% Al after which induction increases to 12% Al and then continues to decrease. It is connected with η phase presence which concentrates in itself Al and C impoverishing the matrix in their respect when Al is below 14% and enriching it as soon as this figure is passed. This is supported by determination of Curie points. Up to 8% Al Curie points do not change remaining around 210° C. which indicates that one deals here with pure cementite. Between 6 and 8% Al a second point around 300° C. is observed. It corresponds to cementite containing some Al. At 10% Al the magnetic transformation point of η phase is observed, which changes with Al content. Magnetic induction of η phase in 12% Al, 1.0 C alloy is calculated. Coercive force is greatly lowered by Al, so that in annealed 12% Al, 1.0% C steel it is the same as in 0.05% C steel, less than 2 oersteds. Hardness passes through a maximum between 12 and 14% Al, both in quenched and annealed state. On drawing quenched alloys pronounced precipitation hardening takes place. Forging permits breaking η phase and cementite so that they become distributed within the grains which gives a material suitable for wire drawing. (11a)

The **Light Metals and Their Alloys (Les Métaux légers et leurs Alliages)** L. Guillet. Dunod, Paris, 1936. Paper, 6½ x 10 inches, 429 pages. Price 138 Fr.

This volume deals with the history, the ores, the production of the metals from the ores, the properties of the metals themselves and the economics involved, while the second, to be written in collaboration with J. Cournot, is to deal with the alloys, their mechanical and thermal treatment and their uses.

In the preface the author states that excellent treatises are available in English and German, but up-to-date ones in French are lacking. The Aluminum Industry, by Edwards, Frary and Jefferies, is so complete that, in this volume at least, relatively little of importance will be found not already adequately covered by those authors. Indeed the American reader will probably find more of interest in the illustrations, showing views of the interior of foreign plants, e.g. those of a 28,000-ampere cell, than in the text itself. The presentation is primarily that of an extensive "correlated abstract," chiefly citing published data, though often with illuminating remarks. However, it is often difficult to tell which of several processes described has the most commercial acceptance.

The sections on Mg, Be, Na, Ca, etc. are much less detailed than that on Al. The book will serve its purpose in France, since nothing so complete is available in French, but, since so much is available in English, the English-speaking metallurgist will be likely to use it but rarely, though its copious references and illustrations in particular make it worthy of a place on the shelves of those having to do with the light metals. H. W. Gillett (11a) -B-

Various Copper-Nickel Alloys (Les divers Alliages Cuivre-Nickel) Joseph Dhavernas. *Cuivre et Laiton,* Vol. 8, Dec. 30, 1935, pages 541-543. Alloys of Ni with Cu, Zn, bronzes and light metals are briefly reviewed. Cu-Ni alloys are now widely used as fire tubes and condenser tubes; the alloy with 20-30% Ni possesses a particularly high resistance to corrosion by seawater. The alloy with 45% Ni, "constantan," has a high thermo-electric force and a fairly constant electric resistance at varying temperatures. Alloys of Cu-Ni-Zn are the so-called "German Silvers" (Ni-silver) with 15 or less % Ni and 45-55% Cu. Ni added to Sn bronzes gives a much finer grain and improves the tensile strength. Al alloys with Ni additions up to 4% show increased hardness and strength. A heat-resistant alloy (Y) is composed of 92.5% Al, 4.0% Cu, 1.5% Mg, 2.0% Ni. Another light metal used for parts of combustion engines is a complex Al alloy containing Ni, Cu, Mg, Fe, Ti and Si. Ha (11a)

Longitudinal Thermoelectric Effect: (5) Silver. J. L. Ch'en & William Band. *Proceedings Physical Society,* Vol. 47, Sept. 1935, pages 904-909. The homogeneous thermoelectric constants for a Ag wire have been determined, and are shown to depend on the longitudinal tension. With zero tension, an abrupt change occurs near 200° C., and this is considered to be connected with the change of elastic limit. JCC (11a)

Plasticity of Bismuth. W. F. Berg & L. Sandler. *Nature,* Vol. 136, Dec. 7, 1935, page 915. Crystals of Bi were grown in vacuum and at atmospheric pressure in H_2, N_2 and CO_2. Under all conditions of growth some of the crystals obtained were soft, with slip occurring in tensile tests at room temperature. It is concluded that previous observations of lack of plasticity of Bi crystals are explained not by gas content but either by orientation unsuitable for slip or by strain hardening of crystals during freezing (especially with Bridgman's method). CSB (11a)

11b. Ferrous

V. V. KENDALL, SECTION EDITOR

Hardening Characteristics of One Per Cent Carbon Tool Steels. T. G. Digges & Louis Jordan. *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 839-860. 8 references. Discussion. 2 C steels were selected from 6 for their wide difference in grain size and hardenability. Prepared in 3 conditions, spheroidized, coarse pearlitic and sorbitic they were studied for grain size, grain growth and critical cooling rates. The composition of the deep hardening (uncontrolled grain size) and shallow hardening (controlled grain size) were respectively C-1.05% and 1.06%, Mn-0.28% and 0.26%, P-0.019% and 0.013%, S-0.013% and 0.011%, Si-0.22% and 0.19%, Cr-0.08% and 0.09%, Ni-0.13% and 0.10%, W not detected, Mo and V less than 0.01%, Al_2O_3-0.006% and 0.010%, acid soluble Al-0.001% and 0.008%, total Al-0.004% and 0.013%, H-0.0002% and 0.0003%, 0-0.007% and 0.009%, N-009% and 0.007%. Quenching temperatures employed were 1475°-1775° F. For temperatures below the solution point for all the C in austenite both grain size and cooling rate depend largely on initial structure. Above this point both steels approach a condition characteristic of the steel except that initial treatment exerts greater influence on the shallow hardening or controlled grain size steel above this point. Controlled steel shows marked change in cooling rate without change in grain size whereas the uncontrolled steel shows marked effect of grain size upon critical cooling rate. WLC (11b)

Heat Resisting High Alloy Chromium Tungsten Steel as a Material for Turbine Buckets. P. B. Mikhailov-Mikheiev. *Kachestvennaya Stal,* No. 8, 1935, pages 39-47. In Russian. For turbines operating at 550° C. and above bucket stock was previously developed which better withstood oxidation and was stronger than the usual low C 12-14% Cr alloy. Its composition was 0.5-0.7% C, 14-18% Cr and 1.5-2.0% Mo. In the present work a steel containing 0.6-0.7% C, 0.4% Si, 0.4% Mn, 17.5% Cr and 2.0-2.1% W was compared with it. The steel is composed in annealed state of ferrite and carbides which fully pass in solid solution only on heating to 1250° C., forming austenite. Its hardness after quenching does not decrease after heating to 1150° C. which was selected as maximum quenching temperature to produce 250 Brinell hardness. Quenching in oil at 1100°-1150° C. and drawing at 820° C. produces optimum properties, yield point 46-53 kg./mm.², tensile strength 73-76 kg./mm.², elongation 21-24%, Charpy impact 2.4-3 kg./cm.² and permits flat bending in cold. Its fatigue limit is 42-44 kg./mm.² as compared with 46-48 for Cr-Mo and 38-40 for 13% Cr steels. Short time tensile tests at high temperatures showed that Cr-W steel is weaker than Cr-Mo though only slightly. Yield point of Cr-W steel remains, however, practically the same, 35 kg./mm.², up to 500° C. while yield point of Cr-Mo steel drops continuously. Scaling resistance of both steels is practically the same up to 900° C. The steel can be used for the purpose intended. (11b)

Tool Steels (Les Aciers à outils) II. André Michel. *Métaux,* Vol. 10, Aug. 1935, pages 180-187. General remarks on alloy tool steels. GTM (11b)

Heat Resistance, High Temperature Strength and Intercrystalline Corrosion of 18-8 Steel Containing Silicon and Aluminum. L. Ya. Liberman. *Kachestvennaya Stal,* No. 8, 1935. In Russian. 4 steels made in a high frequency furnace were studied. They contained 18.5-19.3% Cr, 7.8-8.8% Ni. 3 of them had 0.15% C, the fourth 0.49% C. Their Al content was respectively: 0.33, 0.86, 0.50, 0.98% and Si content: 0.69, 0.93, 2.45 and 2.12%. This corresponds to steels in which the sum of Si and Al equals to 1, 2 and 3% with the same C content and to 3% in case of high C. Low C steels were in solid solution at 1100° C. producing after quenching in water austenitic structure in the first case and austenitic-ferritic structure in the last two. High C steel was not fully in solution at 1200° C. giving a structure of austenite and carbides. Testing for strength up to 900° C. showed that for 0.15% C steels addition of Al + Si in the amounts up to 3% has but little effect on the strength, though the elongation of steel containing 1.8% of these elements is about 8% greater than the corresponding value of two others. Steel with 0.49% C has high tensile strength, but is difficult to forge. Impact values are practically constant for 3 steels with the exception of 0.15% C and 3% (Al + Si) which has a minimum at 700° C. and a maximum at 900° C. Drawing quenched steels at 600° to 800° C. showed that intercrystalline corrosion, as determined by Strauss solution, is absent in 0.15% C steels to which sufficient Al and Si was added to form a 2 phase structure. Steel containing a total of 1% of Al + Si and steel with 0.49% C and 3% Al + Si failed in solution. Heating in air at 800° and 1000° C. showed that 3% of (Al + Si) added to 18-8 steel greatly increases its resistance to scaling. An 18-8 steel containing 2.0-2.5% Si and 0.5-1.0% Al is recommended as having high strength at high temperatures and low scaling characteristics. (11b)

The Wear Resistance of White Cast Iron. O. W. Ellis, J. R. Gordon & G. S. Farnham. *Foundry Trade Journal,* Vol. 53, Dec. 19, 1935, pages 449-452. The tests were conducted in a Greey, motor-driven, 6-jar mill, designed to take end-discharge porcelain jars of standard dimensions. The jars were rotated at 60 r.p.m. The grinding medium was ¼" silicon carbide grain. Swedish wrought Fe, washed metal and West Coast hematite pig Fe formed the basis for every melt. A pouring temperature of 1500° C. was used, this being checked with an optical pyrometer. The sand cast balls were used. The following conclusions were drawn by the authors: (1) Given a suitable abrading medium, the ball mill can be used to measure the wear resistance of white cast Fe. (2) The higher the C content the less consistent are the results of wear tests on cast balls made from these materials. (3) The higher the C content of white cast Fe, other things being equal, the lower is its wear resistance under the conditions of test described. (4) Variations in amounts of Mn up to about 1% are practically without effect upon the wear resistance of white cast Fe. No benefits acrue from adding up to 6% Mn to white cast Fe containing ledeburite. (5) Increase of Si from about ¾% to about 1½% has little or no effect on the wear resistance of white cast Fe, but results in a remarkable increase in that of mottled irons. (6) S is deleterious in its effect on the wear resistance of white cast Fe. AIK (11b)

Wrought Iron, Report of Committee A-2. H. W. Faus, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 70-73. Progress report on Tentative and Standard Specifications and revisions. VVK (11b)

The Properties of Some Low-Nickel Steels Containing Manganese. R. H. Greaves. *Engineering,* Vol. 140, Nov. 29, 1935, pages 593-594. From a paper read before the Iron & Steel Institute, Sept. 1935. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 32R/2. LFM (11b)

Compression Yield Point of Casing Is Increased Sharply by New Process. *Steel,* Vol. 98, Jan. 20, 1936, page 36. Outlines process of A. O. Smith Corp. for producing oil-well casing of greater strength without increased weight. Pipe with larger circumference than desired finished circumference and with proportionately thinner walls, is compressed in a 10,000-ton press, equipped with special dies, to the desired dimensions. For example, pipe originally 7" in diam., with walls 0.362" thick, was reduced to diam. of 6.562" while wall thickness increased to 0.378". Compression yield-point increased from original of 66,000 lbs./in.^{2} to 91,000 lbs./in.^{2} Collapse pressure increased from original of 5450 lbs./in.^{2} to 9150 lbs./in.^{2} Stress at collapse increased from 55,300 lbs./in.^{2} to 84,000 lbs./in.^{2} MS (11b)

Quenching Characteristics of Carbon Tool Steels. V. V. Kuznetzov & N. V. Semenov. *Kachestvennaya Stal,* No. 9, 1935, pages 16-22. In Russian. Steels were classified into deep and shallow hardening after quenching in water at 76° to 900° C. They were made in a 3 ton arc furnace. The study was directed towards the relation between the melting and deoxidation practices and the quenching properties of steel. Steels were deoxidized under a carbide slag and by adding Fe-Si, Al and FeMn. At different stages of heats spoon tests were deoxidized with different substances to study the influence of the latter on the quenching properties. These tests were forged down and quenched from the desired temperature to study their behavior. From 19 heats so produced (it is not clear whether these spoon tests were considered as heats) 17 were shallow hardening and had a wide quenching interval. It was concluded that steels with high O_2 content at the time of melting down do not quench properly after 70 minutes under carbide slags, though they might have 0.7-1.0% C. Quenchability increases with deoxidation. Deoxidation with Al gives small grain and wide range of quenching. Si and Mn action also depended on the degree of oxidation. Quenchability is dependent on the amount of deoxidizers added, time allowed after their addition, degree of slagging of oxides and temperature of the bath. This property is but little affected by subsequent heat treatment, though overheating in annealing increases quenchability of deep hardening steels. (11b)

Gray Cast Iron. John W. Bolton. *Foundry,* Vol. 63, Apr. 1935, pages 18-21, 48, 50, 53; May 1935, pages 27-30, 66; June 1935, pages 22-23, 78; July 1935, pages 21-23, 48, 50; Aug. 1935, pages 38-39, 80; Sept. 1935, pages 32-33, 84, 86; Oct. 1935, pages 36-37, 78; Nov. 1935, pages 36-37 81-82; Dec. 1935; pages 36-37, 80, 83-84. (To be continued.) Series of articles dealing with: (1) The formation and properties of steadite and graphite in cast Fe; (2) Fe-C diagrams; (3) equilibrium diagrams and process of graphitization and their theories; (4) effect of Si in gray Fe, also its effect on graphitization and physical properties, and Si-Fe; (5) effect of Mn in cast Fe; (6) effect of special elements; (7) effect of S in gray Fe and equilibrium diagram of Fe-Si system; and (8) effect of Cr. VSP (11b)

Susceptibility to Quenching and Grain Size of Saw Steel. P. Ya. Barzdain & N. N. Murzin. *Kachestvennaya Stal,* No. 8, 1935, pages 5-19. In Russian. Saws made of 0.70-0.78% C, 0.25-0.40 Mn, 0.35 max. Si, 0.20 max. Cr steel had heavy tooth breakage. 4 heats were made in basic and acid open hearth furnaces and in electric arc furnace to study the influence of the manufacturing processes on the breakage. None of the factors entering them had any influence on breakage of teeth in finished saws with the exception of Al addition to the heat which reduced it. Later 46 heats were investigated in order to bring out the relation between susceptibility to quenching and grain size and breaking of teeth. Coarse grained steels were quenched in a narrow range and were associated with failure of teeth. Fine grained steel had a wide quenching range and had a greatly reduced breaking of teeth. Best results are obtained with grain size of 6 to 8 (ASTM). Paper gives a very detailed treatment of all factors involved. (11b)

Influence of Common Alloying Elements on Properties of Steel (Influence des éléments ordinaires d'alliage sur les propriétés de l'acier) Edgar C. Bain. *Revue de Métallurgie,* Vol. 32, Nov. 1935, pages 553-561. Basic reactions of thermal treatment of alloy steels are all present in common C steels. Alloying elements change only speed and intensity of these reactions and temperatures at which they occur. The best properties at room temperature obtainable with certain sections and mass C steel samples are only moderately though definitely lower than those of the corresponding type alloy steels. The factors defining the final properties of C steel are the same as for alloy steels, but C steel has certain limitations which are eliminated by addition of alloys. Dissolving in austenite on heating before final cooling they affect profoundly speed and type of transformations and, therefore, the final structure. The lower the temperature at which transformation actually takes place, the finer the division of the carbide particles and the harder the metal. Transformation takes place rapidly at higher temperatures, and to prevent them from taking place the steel must have a certain critical speed of cooling which would carry it without transformation through the higher temperature range to about 150° C. where martensitic transformation takes place. Alloys reduce it. All alloying elements with the exception of Co which actually dissolve in austenite before quenching increase the depth of quench penetration. Grain size of austenite crystals inversely affects physical properties of heat treated steels, and alloying elements refine the grain either by formation of finely divided solid oxides in deoxidation, or by forming insoluble carbides during solidification. Deep quenching can be produced here either by adding some other element or by a partial solution of the carbide forming alloy, such as Mo. The nature of the carbides formed by alloying substances has influence both on the grain size and speed of transformation depending on their stability at higher temperatures. JDG (11b)

B. S. 3. S. 11 Steel in Aircraft Structures. P. L. Teed. *Metal Treatment,* Vol. 1, Autumn 1935, pages 135-140, 142. A detailed study of the longitudinal and tranverse mechanical properties of forged bars of various diameters of the above nickel-chromium steel, and of the influence of tempering temperature. Too high a tempering temperature causes low values of 0.1% proof stress, and it is recommended that requirements for this property should be specified. Repeated hardening and tempering had no adverse effects if done as specified, but water quenching is liable to cause cracking. JCC (11b)

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12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

Modern Refining Requires Extensive Use of Alloy Steels for Equipment. H. D. NEWELL. *Oil & Gas Journal,* Vol. 34, Feb. 20, 1936, pages 32-34. In an effort to develop an alloy intermediate between 18-8 Cr-Ni and 5% Cr steel, the nominal composition was obtained of 9.25% Cr, 1.50% Mo, and .12% C and was given the trade name "Croloy 9". Tables of physical properties of 8-10 Cr steel with various additions of Mo, V, and W are given. The chosen alloy has stainless properties approaching those of 12% Cr-iron alloys and for this reason may be termed "semistainless" as contrasted to the complete stain-resisting qualities of 18-8 and the nonstainless qualities of 5% Cr steels. Tubes of this alloy are in service in many oil refineries. Some 10 commercial electric furnace heats have been processed into tubes with all indications that the alloy can be satisfactorily handled in rolling bars and in piercing and rolling tubes. As annealed, tubing has good ductility and may be readily expanded, formed or bent. In welding, practices must follow those acceptable for 5% or higher Cr steels. Susceptibility ratio tests of impact specimens show the alloy to be free from any tendency toward embrittlement when cold with excellent ductility when hot. Tubes meet the following minimum physical requirements: tensile strength 75,000 lbs./in.^{2}; yield point, 30,000 lbs./in.^{2}; elongation in 2", 30%; and Brinell hardness, 180 max. It is suitable for elevated temperature service up to about 1250° F. metal temperature in such applications as furnace tubes and heat exchanger tubes for oil refining and for superheater tubes in steam boilers. VVK (12)

Refractory Chromium Cast Irons (Les Fontes Refractaires au Chrome) PAUL BASTIEN. *Chaleur et Industrie,* Vol. 17, Jan. 1936, pages 13-14. Cr in cast Fe tends to keep C in the combined state, forms a solid solution with the Fe carbide and refines the structure. Its effect at high temperatures is to stabilize the cementite and prevent graphitisation, to raise the transformation temperatures, and to form adherent protective films. Fe with 0.5 to 0.7% Cr is practically stable at temperatures up to 800° C., and with 1-3% Cr, may be used up to 900° C. High Cr irons with up to 37% Cr, and often with additions of Si and Al are serviceable at higher temperatures. JCC (12)

The Utilisation of Creep-Test Data in Engineering Design. R. W. BAILEY. *Engineer,* Vol. 160, Dec. 6, 1935, pages 592-594; *Engineering,* Vol. 140, Nov. 29, 1935, pages 595-596; Dec. 13, 1935, pages 647-651. From a paper read before the Institution of Mechanical Engineers, Nov. 22, 1935. LFM (12)

Silicon Cast Irons (Les Fontes au Silicium) LÉON GUILLET. *Chaleur et Industrie,* Vol. 17, Jan. 1936, pages 14-15. A brief survey of the characteristics of cast Fe containing up to 15% Si. For heat-resisting service, the C and Si contents should be adjusted so that a ferritic hypoeutectic structure exists throughout the temperature range employed. Cast Fe with 6% Si and 2.8% C is satisfactory up to 950° C. JCC (12)

Behavior of Mild Steel Under Prolonged Stress at 300° C. C. H. M. JENKINS. *Iron & Coal Trades Review,* Vol. 131, Sept. 20, 1935, pages 434-435. Paper read before the Iron & Steel Institute, Sept. 1935. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 79R/5. Ha (12)

Refractory Cast Irons in the Construction of Heat Exchangers (Fontes Refractaires dans la Construction des Echangeurs Thermiques) LE THOMAS. *Chaleur et Industrie,* Vol. 16, Dec. 1935, pages 533-536. Structural changes which occur in cast Fe on heating, and the influence of added elements on these are discussed. At steady temperatures below 400° C. ordinary cast Fe corrodes appreciably less than steel; for steady temperatures up to 500° C. "pearlitic" Fe is recommended; up to 800° C., Fe with 0.5-0.7% Cr; and up to 1000° C., Fe with 1.0 up to 3.0% Cr. The latter is very fragile and will not withstand variations in temperature. For rapidly varying temperatures, or in corrosive atmospheres, 5-7% Si iron is recommended; and for particularly severe corrosive conditions low-C iron with 30-34% Cr or austenitic Ni-Cu-Cr irons are suitable. JCC (12)

Metals for Heat Exchangers (Les Materiaux Metalliques pour Echangeurs Thermiques) ALBERT PORTEVIN. *Chaleur et Industrie,* Vol. 17, Jan. 1936, pages 11-13. A brief survey of the characteristics of special steels and cast irons at high temperatures. In making a choice of materials for high temperature service, long-time tests on mechanical resistance, corrosion resistance to hot gases, and expansion through graphitisation are desirable. Short time time tests can only be used for preliminary elimination. JCC (12)

An Investigation of the Nature of Creep Under Stresses Produced by Pure Flexure. H. J. TAPSELL & A. E. JOHNSON. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 121-140; *Engineer,* Vol. 160, Oct. 4, 1935, page 342; *Engineering,* Vol. 140, Oct. 4, 1935, page 372. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 79R/2. LFM (12)

Scientific and Industrial Research. *Engineer,* Vol. 161, Jan. 10, 1936, pages 54-57. From the Report of the Department of Scientific & Industrial Research for the year 1934-1935 published by H. M. Stationery Office. A brief summary of research on the behavior of materials at high temperatures and on light alloys. LFM (12)

13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

Determination of Corrosion on Underground Pipe Lines and Methods Used in Mitigation of Problem. G. C. GABLER & O. C. MUDD. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 54-67. Comprehensive and practical discussion with the following general conclusions. Mitigation of corrosion on underground pipe lines and structures by cathodic protection is practical. Degree to which this protection is to be carried depends upon the economic returns to be realized. Principal factors will be prevention of loss of commodities, prevention of damages, curtailment of maintenance and recovery value of equipment. Figures on which the degree of such protection are to be based will depend upon the accurate record of expenditures and observations of companies engaging in such work. Coordination of such information will also assist in establishing a sound basis for such work. Methods of providing cathodic protection are dependent upon cost and reliability. Where power from sources of mechanical generation is not available, the installation of Zn anodes offers the most practical solution to date. VVK (13)

Experiences and Developments in the Electrical Protection of Pipe Lines. STARR THAYER. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 120, 122. A general discussion of cathodic protection of pipe lines. This method of protection may be used in many instances to save heavy replacement or reconditioning expenditures. It may also be used on new lines that are not as yet producing any corrosion troubles as an insurance against trouble in the future. VVK (13)

General Consideration on Mitigation of Electrical Corrosion of Pipe Lines. VINCENT LEE NEALY. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 85-90. Detailed accounts of installations of cathodic protection on pipe lines of The Texas Pipe Line Co. Data are given on the operation of the wind-driven generating unit previously described. See "Cathodic Protection on Pipe Lines by Wind Driven Generator Unit," *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 374R/8. VVK (13)

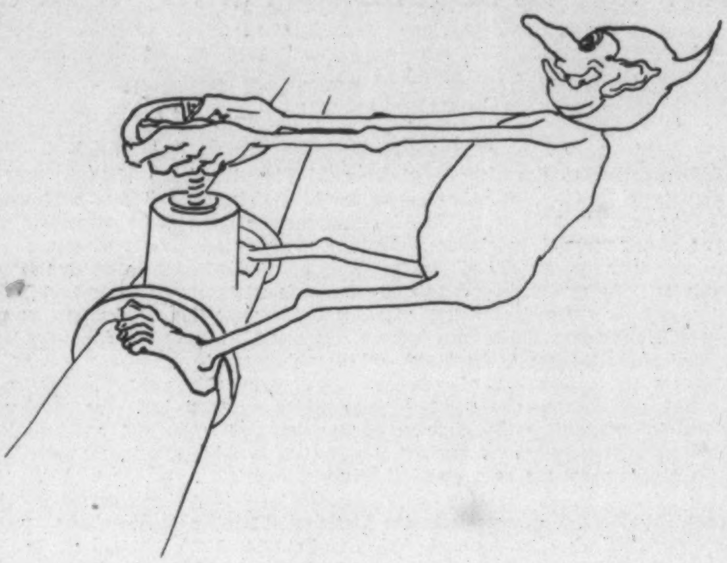
Electric Pipe Line Drainage a Practical Alternative to Reconditioning Pipe. GEO. I. RHODES. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 130-136. A comprehensive review of cathodic protection of pipe line systems from a practical and economical standpoint with particular reference to a paper by the author before the Natural Gas Department of the American Gas Association in May 1935. Data are also given showing by leak records that cathodic protection is entirely effective with a time lag of about 6 months, i.e. leaks will be entirely stopped about 6 months after cathodic protection is turned on and after it is turned off it will be 6 months before leaks will again develop. VVK (13)

Sucker Rod Failures Often Traceable to Incorrect Practices in Oil Fields. W. R. SHIMER. *Oil & Gas Journal,* Vol. 34, Sept. 5, 1935, pages 48, 50. The treatment a sucker-rod receives in the field is as important in determining the life to be expected from the rod as the manufacture of the rod itself. Rods, metallurgically correct when leaving the mill, have not given good service. The author points out various abuses such as bending or nicking in handling; not tightening a coupling sufficiently will invariably cause pin breaks; high overloads due to too quick taking up of slack, etc. Rods taken out of a bad sulphide well were so brittle that they could be broken by a light tap of a hammer; in 3 weeks the brittleness had disappeared. The author suggests if possible a periodic low anneal or heating for sucker-rods used in sulphide wells to remove brittleness. Careful observation and records of the use accorded sucker-rods in the field will solve many "mystery" failures. VVK (13)

Action of Solutions of Sodium Silicate and Sodium Hydroxide at 250° C. on Steel Under Stress. W. C. SCHROEDER & A. A. BERK. *Metals Technology,* Jan. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 691, 14 pages. Special equipment was used for stressing steel specimens in aqueous solutions at 250° C. A given stress was maintained until the specimen broke or until it had been applied for from 4 to 12 days. Straub had found that in solutions of caustic soda steel failed by "caustic embrittlement." Such embrittlement was not found with C.P. NaOH. Straub had used commercial NaOH. Analysis of this material showed it to contain an appreciable amount of silicate. Tests in solutions of silicate and NaOH plus silicate indicated that the silicate was responsible for the embrittlement, which resulted in the failure of the specimens at comparatively low stresses in a few hours. Intercrystalline cracks were formed in the specimens stressed in silicate solutions. JLG (13)

Care and Preservation of Bronze Statues. WESLEY LAMBERT. *Metal Industry,* London, Vol. 47, Aug. 2, 1935, page 107. The author believes it necessary that the custodian of bronze statuary exposed to the elements have knowledge of corrosion of metals. The distinctive coloring and patina should not be maintained at the expense of the metal itself and by loss of detail. The most desirable cleansing reagents and the best remedial measures have been developed by those who are students of atmospheric corrosion and familiar with the corrosive action of the atmosphere on different metals. Water is recommended as the best cleansing reagent but very small additions of soap powder or ammonia are suggested as sometimes permissible. Extreme care is necessary to prevent staining of marble. In the study of preservation of metals coatings tested have been grouped into (1) transparent lacquers and varnishes and (2) waxes and greases. The disadvantages of the first group are indicated and it is stated that preservatives of the second group are most popular in Great Britain. A mixture of bees-wax and turpentine is the most popular. It is not permanent but when used 3 times a year is an excellent safeguard. HBG (13)

Metals in Wineries. CHARLES S. ASH. *Industrial & Engineering Chemistry,* Vol. 27, Nov. 1935, pages 1243-1244. It has been found that the ability of various metals to resist the corrosion due to hot (about 95° C.) wine and fruit juices is as follows: Cr-steel (18-8), silicon irons such as Duriron, Corrosiron, bronzes (Amberac, Tobin), Cu, Monel metal, brass, Ni, Al, Al-alloys, wrought Fe, steel, Pb, Sn, cast Fe, Zn. The results of tests with vinegar on Cr-steels and Duriron are also given. MEH (13)



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Additions which Reduce the Attack of Solutions on Aluminum (Angriffvermindernde Zusätze zu das Aluminium angreifenden Lösungen. Addition de produits immunisants aux solutions corrodant l'aluminium) H. Röhrig. *Aluminium,* Vol. 17, Nov. 1935, pages 559-562; *Revue de Métallurgie,* Vol. 32, Nov. 1935, pages 577-580. The disintegration of Al by alkali solutions is prevented not only by additions of Na silicate (as discovered in 1929) but also by other colloidal substances such as animal and vegetable glues. As an explanation of this protective action it is assumed that the colloids deposit on the metal surface because of their electric charge. Experiments were made with nicotine and nicotine sulphate in HCl solutions, dibenzyl sulphide in HCl solutions, and several special solutions from different makers with pure Al and Al alloys; the results are shown in tables and show remarkable reductions in the amount of metal dissolved. A number of industrial and domestic applications are described. Ha + JDG (13)

Effect of Smoke on Building Materials. H. B. Meller & L. B. Sisson. *Industrial & Engineering Chemistry,* Vol. 27, Nov. 1935, pages 1309-1312. Reports and observations show continuation of excessive air pollution and resultant damage to building materials. Effects of tarry matter and S compounds resulting from combustion of fuel are discussed, complications caused by city smoke in air-conditioning, and efforts to develop materials and protective coatings more resistive to air-borne corrosive agencies are noted. It is remarked that the progress and development that is manifested by the production of such materials as stainless steels, tiles, porcelains, anodic Al finish, should be matched by the progress in air purification. MEH (13)

Age Hardening and Corrosion. E. Söhnchen. *Metal Treatment,* Vol. 1, Autumn 1935, pages 121-122. Translation from *Die Giesserei.* See "Precipitation Hardening and Corrosion," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 417L/6. JCC (13)

The Protection of Magnesium Alloys Against Corrosion. H. Sutton & L. F. LeBrocq. *Engineer,* Vol. 160, Oct. 4, 1935, page 343; *Engineering,* Vol. 140, Oct. 11, 1935, pages 398-399; *Metal Industry,* London, Vol. 47, Sept. 13, 1935, page 274. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 34R/7. LFM + HBG (13)

Die-Cast Metals and Alloys, Report of Committee B-6. J. R. Townsend, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 181-183. Progress report. **Appendix I: An Investigation of Aluminum Die-Casting Alloys Nos. IVa and Va.** E. E. Thum, Chairman. pages 184-189. Outline of an investigation of a 5% Si and a 12% Si Al die-casting alloy. Analyses and original mechanical properties are given. Subsequent reports will cover the accelerated or the atmospheric corrosion tests. **Appendix II: Report of Subcommittee V on Exposure and Corrosion tests.** W. M. Peirce, Chairman. Pages 190-226, discussion pages 227-229. This report covers the results of the first 5 years of exposure tests of 12 Al and 10 Zn alloys cast by several producers and exposed at 6 outdoor and 4 indoor locations. The general conclusion is that with the Al alloys no significant changes have been induced by corrosion and only small changes have resulted from aging. The following conclusions are drawn on the Zn alloys. The superiority of alloys prepared with high-purity Zn (99.99+%) over those prepared with high-grade Zn (99.90%) which was demonstrated in the 95° C. steam tank is confirmed by the 5-yr. exposures. The steam test causes corrosion due to the combined effect of moisture and heat and also aging changes due to the effect of heat alone. Comparison of the effects of the steam exposure, exposure to dry heat, and the various atmospheric exposures show that the results of the steam test, when properly interpreted, afford a reliable and rapid means of predicting whether intercrystalline corrosion will occur under atmospheric exposure conditions over long periods of time. VVK (13)

Corrosion of Non-Ferrous Metals and Alloys, Report of Committee B-3. T. S. Fuller, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, page 141. **Report of Subcommittee VI on Atmospheric Corrosion of Non-Ferrous Metals and Alloys.** W. H. Finkeldey, Chairman. Pages 142-159. This report presents results of the atmospheric corrosion tests on 24 non-ferrous metals and alloys after an exposure of approximately 3 years. The data on changes in weight, changes in tensile strength, and visual examination are given in the form of tables. **Report of Subcommittee VII on Corrosion in Liquids.** A. J. Phillips, Chairman. Pages 160-166. Data are reported on an 8-month sea water exposure test of 20 materials; 13 materials in NaOH; and 16 materials in H_2SO_4. **Report of Subcommittee VIII on Galvanic and Electrolytic Corrosion.** C. L. Hippensteel, Chairman. Pages 167-175. This report presents the results of dissimilar metals in contact in outdoor exposure at 9 locations after 3 years. VVK (13)

Reconditioning Natural Gas Pipe Line Without Any Interruption to Service. A. L. Forbes, Jr. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 102-103. Details of the reconditioning of the 16" natural gas line between Ysleta and Clint, Tex. which operates under a pressure of from 250 to 300 lbs. without disturbing service. VVK (13)

Corrosion of Iron and Steel, Report of Committee A-5. F. F. Farnsworth. Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 81-85. The Committee offers 3 new proposed tentative specifications for electrodeposited coatings: (1) of Zn on steel, (2) of Cd on steel and (3) of Ni and Cr on steel. (1) and (2) require a minimum thickness of 0.0005" Zn or Cd for general service and 0.00015" for mild service. (3) requires a minimum thickness of 0.00075" Ni or combined Ni and Cu for general service. (If Cu is used the minimum thickness of the final Ni layer should be 0.0004"). For mild service, the Ni or the combined Ni and Cu should be 0.0004" and if Cu is used, the minimum thickness of the final layer should be 0.0002". If a Cr finish is specified, the minimum thickness of the Cu and Ni layers should be as above and the average thickness of the Cr should not be less than 0.00002". The atmospheric test at Annapolis and the Key West and Portsmouth sea water immersion tests are continuing. **Report of Subcommittee VIII on Field Tests of Metallic Coatings.** R. F. Passano, Chairman. Pages 88-103. Progress report. The additional data confirm the tentative conclusions of last year, namely that at a given location the amount of protection is substantially in accord with the weight of coating and that the same weight of coating gives quite different amounts of protection at different locations. Data on the coated hardware, structural shapes, tubular goods, etc. are given in the form of tables. VVK (13)

Why Metals Corrode. R. M. BURNS. *Monthly Review American Electroplaters' Society,* Vol. 22, Nov. 1935, pages 33-46. Corrosion is defined in general terms as the chemical reaction of a metal with a non-metal. Metals corrode because it is their inherent tendency to react with non-metals with attendant liberation of energy, usually in the form of heat. Corrosion may also occur by replacement, i.e. the metal displaces H_2 from water, or other compounds, and goes into solution itself. The rusting of Fe by water or acids is an example. The original metal may also displace another metal from solution which is illustrated when Zn is placed in a solution of $CuSO_4$ and a film of Cu appears on the Zn surface. The mechanism of the above mentioned corrosion actions is electrolytic-the existence of small anodes and cathodes. Corrosion cells are set up under various conditions. Thus an annealed region of a metal may be cathodic to a strained region which will be anodic (dissolves). Other types of cells are given in a table:

Nature of Couples Comprising Corrosion Cells.

Cathode	*Anode*
Noble metal	Base metal
Oxide	Metal
Dust (carbon)	Metal
Annealed metal	Strained metal
Large metal crystal	Small metal crystal
Metal (O_2)	Metal (Absence of O_2)
Metal in high M ion concentration	Metal in low M ion concentration
Metal in high H ion concentration	Metal in low H ion concentration

GBH (13)

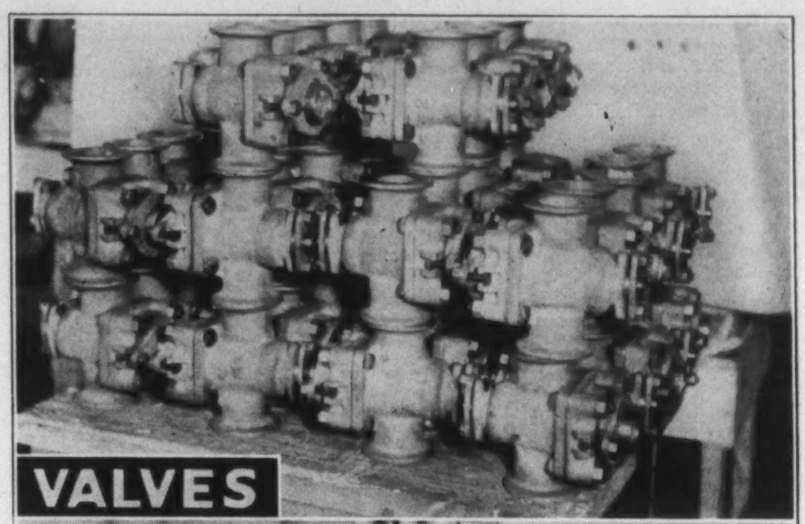
Metallic Wear. H. W. BROWNSDON. *Journal Institute of Metals,* Vol. 58, Dec. 1935, pages 535-549 (Advance Copy No. 720). A special machine for measuring wear was constructed. In this machine a rotating steel disc was pressed against the metal to be tested, the latter being in the form of a thin plate. The periphery of the disc was rounded to a radius of 0.05", the diameter of the disc being 1" and its thickness 0.1". Wear was determined by measuring the dimensions of the impression made by operation of the disc under a definite pressure for a definite time. Tests were made with plenty of lubrication, a light machine oil being used in most tests. Tests with a soap solution showed that for some alloys wear was greater with this and for others wear was greater with oil. The rate of wear depended to a large extent on whether or not the metal seized. Alloys with a duplex structure did not appear to have a higher wear resistance than other alloys. Cold working did not change the wear resistance of Cu alloys. Increasing the Sn content of Cu-Sn did not change wear resistance. JLG (13)

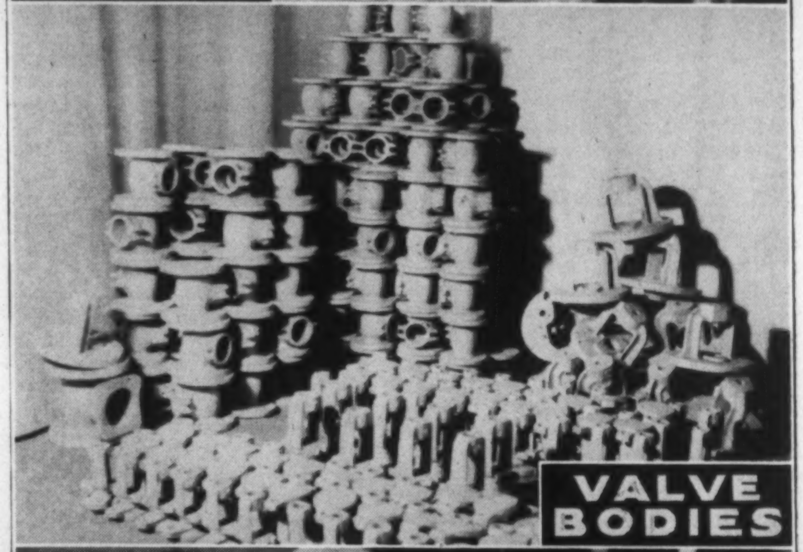
The Resistance of Galvanized Iron to Corrosion by Domestic Water Supplies. S. C. BRITTON. *Chemistry & Industry,* Vol. 55, Jan. 24, 1936, pages 19T-22T. An extensive series of laboratory experiments were made with steel and Zn (either sheet Zn or galvanized Fe) immersed in solutions containing the salts present in public H_2O supplies, having a wide range of pH values and degrees of salinity. The Zn sheet had a composition similar to galvanizing (Pb content 1%). The composition of the steel used was 0.108% C, 0.40% Mn, 0.062% S and 0.039% P. The data resulting from the tests may be briefly summarized as follows: (1) H_2O having a pH of 7.5 and 8.5, and containing $CaCO_3$, but low SO_4, Cl and NO_3 radicals is initially corrosive to Zn. The rate, however, drops to zero after a short time; Fe is evenly and progressively attacked. (2) H_2O low in $CaCO_3$ and appreciable amounts of SO_4, Cl and NO_3 radicals is both initially and progressively corrosive to Zn, evidenced by deep and preferential pitting; Fe corrodes evenly. The difference between Zn and Fe corrosion characteristics appears to be due to an insoluble and highly protective film of $CaCO_3$ which forms on the Zn, but not on Fe. The deciding factors for corrosion of Zn in the above described water supplies are, thickness of Zn deposit, $CaCO_3$ content, pH value and conductivity. AAA (13)

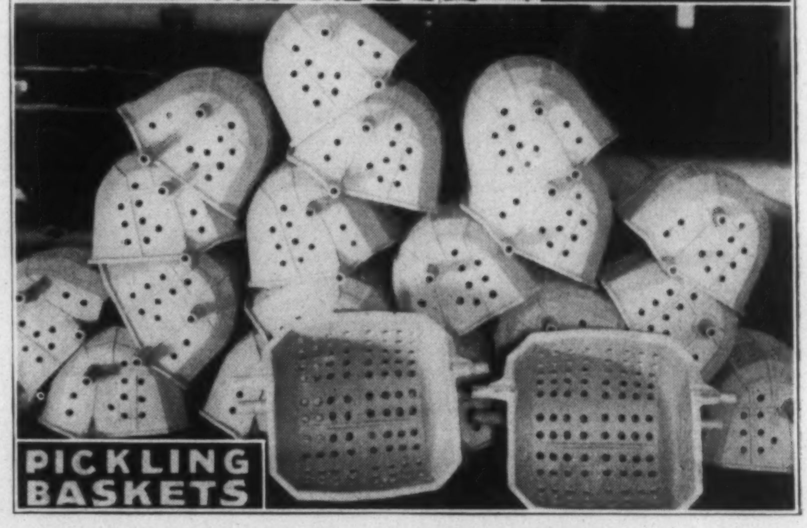
Influence of Heat Treatment on the Corrosion Resistance of Plated Duralumin (Einfluss der Wärmebehandlung auf die Korrosionsbeständigkeit von plattiertem Duralumin) P. BRENNER. *Zeitschrift für Metallkunde,* Vol. 27, Aug. 1935, pages 169-174. With discussion. Duralumin sheets of 0.5 and 1.0 mm. had an 0.03 mm. Al plate free from Cu on both sides, while 1.5 mm. sheets had an 0.05 mm. plate. These were initially in an untreated soft condition and hardened (a) by quenching in H_2O from 500° and holding at 20° for at least 5 days, (b) by air cooling from 350°, heating to 500° for 10 minutes, quenching in H_2O, and aging at 20° for at least 5 days. Micrographs showed the protective layer to be quite distinct on the original material, but after 30 minutes of treatment (b) half of the zone had vanished, and 60 minutes of type (a) caused diffusion to extend to the surface of the 0.03 mm. plates, though this zone did not disappear after 5 hrs. of (a) with 0.05 mm. plates. Accelerated corrosion tests were made at room temperature in solutions containing 3% NaCl + 0.1 H_2O_2. After various periods of exposure, measurements of tensile strength and elongation showed that resistance to corrosion was best when diffusion was the least, but that plated material was always superior to straight duralumin. Similar corrosion tests in sea water showed nearly complete resistance for all plated samples over a 2-year period. Plating was also shown to be effective for samples aged at 140°, when subjected to a salt spray test while strained. GD (13)

Questions of Rust Protection (Ueber einige Rostschutzfragen) A. V. BLOM. *Korrosion & Metallschutz,* Vol. 11, Nov. 1935, pages 245-249. Destruction of materials by corrosion, protective coatings, preparation of the surface to be protected and qualities of coatings are discussed in a general way. The protective coat should be applied only to thoroughly cleaned and perfectly dry Fe, unless bituminous emulsions are used. The ground coat should be of red lead or chromate under oil paints, and of a bituminous nature under bitumen lacquers. Directions for correct application and timing of application, and for selection of the coat are given. Ha (13)

Equipment Corrosion in Kansas Wells Is Retarded by Chemical Treatment. L. G. E. BIGNELL. *Oil & Gas Journal,* Vol. 34, Oct. 3, 1935, pages 32-35. The unusually severe corrosion problems present in producing fields of eastern and western Kansas are finding solution in the systematic application of chemicals. Wells are treated with caustic soda, Na cresylate, dichromate or chromate, alkaline solutions of tannic acid and similar organic acids or compounds such as tan bark, extracts of chestnut, oak, and the alkaline reacting solutions of Na aluminate, Na silicate and similar inorganic compounds. The object of the particular treatment may be the inhibition of corrosion, of the formation of heavy scale or both. VVK (13)







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Internal Corrosion of Sour Crude Oil Pipe Lines Presents Serious Problem. Walter F. Rogers. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 69-75. The handling of sour crude oil has been found to result in rapid internal corrosion of the pipe line equipment. The average service life which has been found to be obtained in handling sulphide crudes from the older Gulf Coast oil fields approaches 8 yrs. as a maximum. Internal corrosion of main trunk lines is not as rapid as that of gathering lines, but the recent development of rust holes through the interior of West Texas sour oil trunk lines show that rapid attack is occurring. Pipe line station manifolds and suction lines will have average service lives approaching 10 yrs. The internal corrosion attack can be reduced or stopped by removing either or both the H_2S or the water from the crude oil. No method for removing the H_2S economically has been found. The only practical means of handling the water so it will not result in rapid attack of gathering lines is to lay the lines at a slope so the settled water can gravitate to catch basins. For trunk lines it has been determined that certain velocities will prevent brine and bottom settlings and water from settling in the pipe. The use of these velocities will prevent internal corrosion from occurring. It is of importance that all air be kept from the sulphide-bearing oil if possible. This can best be accomplished by the use of vapor tight lease equipment and tight pipe line storage tanks. The use of oxygen free gas systems on these tanks to prevent oxygen access during breathing periods will result in lessened corrosion losses to both the pipe lines and the tank equipment. Cement lined pipe is recommended as a corrosion resistant pipe for gathering and suction lines. VVK (13)

The Corrosion of Pb Alloy Coated Steel Cylinders Used as Fire Extinguishers. W. L. Hewlett. *Chemistry & Industry,* Vol. 54, Dec. 20, 1935, pages 1094-1095. Chemical type fire extinguishers, i.e. the $NaHCO_3$-H_2SO_4 type and the foam mixture type ($NaHCO_3$, Saponin + $Al_2(SO_4)_3$), are occasionally subject to severe corrosion and frequent replacement. Corrosion appears to be confined to the interior of the cylinders which, in both types of extinguishers, consists of Pb-Sn alloy lined steel. The author is of the opinion that the salts in the water used in making the $NaHCO_3$ solution are chiefly responsible for the corrosion, which he proves by exposing ordinary C steel, Pb-Sn alloy, and C steel and Pb-Sn together in $NaHCO_3$. Amount of corrosion in each case was negligible. Although a porous Pb-Sn alloy coating accelerates iron corrosion in the beginning, the reaction subsides due to the formation of an oxy-carbonate film. The radicals Cl, SO_4, NH_3 salts and organic acids prevent film formation and accelerate corrosion. As a remedy, the following is recommended (1) the use of salt free H_2O, (2) addition of 2 oz. $Na_3PO_4.12H_2O$/gal. AAA (13)

Atmospheric Exposure Tests on Non-Ferrous Screen Wire Cloth. G. W. Quick. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 458-476. Report of Subcommittee IV of Committee D-14 on Screen Wire Cloth. Final results of a 9-yr. atmospheric test at 4 locations of 7 alloys (90-10 Cu-Zn; 80-20 Cu-Zn; 75-20-5 Cu-Ni-Zn; 70-30 Ni-Cu; Cu; 98-2 Cu-Sn; 95-5 Cu-Al) in the form of screen wire cloth. Tension tests were made before and after exposure. No correlation was found between the atmospheric results and accelerated tests in salt spray, dilute H_2SO_4 and in NaCl. The severest damage to each material was caused by the heavy industrial atmosphere at Pittsburgh. In the mildly corrosive atmosphere at Washington, no failures occurred in any of the materials during the entire period. In the temperate and tropical seacoast atmospheres of Portsmouth and Cristobal with some industrial contamination at both exposure stations, there was more damage to each material than at Washington. No conclusions aside from tables and charts are drawn as to the relative corrodibility of the materials. However the 98-2 Cu-Sn and Cu (unalloyed) lost the least in tensile strength and the 70-30 Cu-Ni, 80-20 Cu-Zn, and 95-5 Cu-Al alloys lost the most in tensile strength at most of the locations. See also *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 34L/6. VVK (13)

Pipe Cleaning. Charles Haydock. *Journal American Water Works Association,* Vol. 27, Nov. 1935, pages 1566-1571. Discussion of the cleaning of tuberculated water mains. VVK (13)

Progress in Corrosion- and Heat-resisting Steels. W. H. Hatfield. *Metallurgia,* Vol. 13, Dec. 1935, pages 41-44. Reviews development and uses of these alloys. All alloys discussed contain Cr. JLG (13)

Corrosion and Water are Problems at Rincon Plant. *Refiner & Natural Gasoline Manufacturer,* Vol. 14, July 1935, pages 357-358. A very corrosive water was successfully treated with lime-soda-sodium aluminate. Pipe lines in very corrosive soil were coated with 4 coats of pipe line grease and grease saturated wrappers. No further trouble was encountered. VVK (13)

Report of Committee on Electrolysis and Electrical Interference. N. S. Hill Jr., Chairman. *Journal American Water Works Association,* Vol. 27, Nov. 1935, pages 1581-1588. The committee recommended that the American Water Works Association revoke and rescind any and all previous approval or sanction of the practice of grounding electric light and power circuit on water pipes for protective or other purposes. The recommendation was adopted. The committee pointed out that sufficient currents were carried by the water pipes to constitute a hazard. VVK (13)

Surface Preparation and Painting of Magnesium Alloys. A. W. Winston, J. B. Reid & W. H. Gross. *Industrial & Engineering Chemistry,* Vol. 27, Nov. 1935, pages 1333-1337. Paint adhesion and protection against sea water are the main problems in connection with the painting of Mg-alloys. Pretreatment of the metal surface by chemical means such as a short dip in sulphuric acid-sodium dichromate solution, is recommended. The effect of the composition of the primer and finish coats on adhesion and protection is discussed. Tables of data are given showing the relationship between alloy, condition of chrome-pickle solution, coating, and paint adhesion. 14 references. MEH (13)

Permanent Pipe Line Reconditioning Plant Utilizes Heat and Sand Blast. Neil Williams. *Oil & Gas Journal,* Vol. 34, Nov. 28, 1935, pages 28-32. Description of the sand blast equipment of the central reconditioning plant of the Houston Pipe Line Co. at Edna, Texas. VVK (13)

New Practices Used in Pipe Conditioning to Combat Corrosion. Neil Williams. *Oil & Gas Journal,* Vol. 34, June 20, 1935, pages 14, 42. The pipe coating practice of the Houston Pipe Line Co. is described, particularly the "holiday detector" in use. VVK (13)

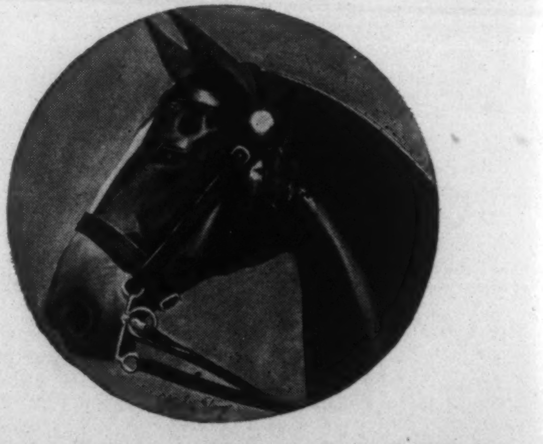
Heat Resisting Cast Irons. Albert Portevin. *Metal Progress,* Vol. 28, Dec. 1935, pages 67-68. Transfer of the principles regarding alloy additions to steel to achieve oxidation resistance, to cast iron is complicated by graphitization with expansion in volume and internal cracks from inequalities in this action and penetration of hot gases into these cracks. In order to control these factors (1) suppress graphitization by addition of carbide stabilizing alloys (Cr, Mn, W, Mo, or V) or completely graphitize by additions of Si, Ti, or Ni; (2) make additions (Al, Si, or Cr) to render completely ferritic over the range of operating temperatures; (3) improve oxidation and sulphurization resistance by additions of elements producing adhesive films (Cr, Al, Si, and Zr) and avoid elements causing intergranular decay (Ni in S atmosphere). Such irons fall into two classes: (1) 35-40% Cr (with additions of Si, Al and Zr) to produce a ferritic or carbide cast iron, (2) Si, Al, or Si-Al cast iron which are ferritic and graphitic in structure. Castibility test can be used for control of Si content which should be slightly hypoeutectic at 5.5% Si. Al irons have poor mechanical properties. Al-Si combination is 6.5-7.0% Al with 5.0-6.0% Si and 1.80-1.90% C, a difficult range to hit in foundry practice. WLC (13)

Action of Dilute Acids on Aluminum. Charles F. Poe, R. M. Warnock & A. P. Wyss. *Industrial & Engineering Chemistry,* Vol. 27, Dec. 1935, pages 1505-1507. The loss in weight of a very pure sheet Al was determined for various inorganic and organic acids, about 30 in all, at concentrations of 1.0, 0.1, and 0.01 normal, and 25° C. One set of tests was made with 0.1 normal acids boiled for 30 min. daily. All immersions continued for 12 weeks, and the loss in weight is recorded for 2, 4, 6, 8, and 12 weeks' immersion. 19 references. MEH (13)

Continuous-flow Corrosion Tests of Steel Pipe. H. S. Rawdon & L. J. Waldron. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 233-248; *Engineering,* Vol. 140, Aug. 23, 1935, pages 208-209. See *Metals & Alloys,* Vol. 6, Jan. 1936, page MA 36L/5. LFM (13)

Reconditioning Water Supply Lines with Bituminous Enamel. Linden Stuart. *Journal American Water Works Association,* Vol. 27, Aug. 1935, pages 1055-1064. Review of the reconditioning of water mains. The coating advocated is a compounded coal tar pitch base coating of at least 1/16" thickness. Advantages are given. VVK (13)

Present-Day Maintenance of a Pipe Line System Calls for Efficiency. J. Campbell Stirling. *Oil & Gas Journal,* Vol. 34, Oct. 24, 1935, pages 91-95. The history and experiences of the Stanolind Pipe Line Co. in reconditioning their pipe lines are given. In general it is more economical to maintain pipe lines by a systematic plan than to neglect them and postpone the maintenance work through the use of temporary repairs. Extensive reconditioning on field gathering lines, on lines smaller than 6" in size or on lines of only a short economic life is not done. Smaller lines extending across salt water drains, slush ponds, and the like are protected by supporting the lines on props across such corrosive areas. VVK (13)



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14. APPLICATION OF METALS AND ALLOYS

Stainless Steel, Nickel, and Nickel Alloys Solve Food Equipment Fabricator's Problems. G. H. Tay. *Food Industries,* Vol. 8, Feb. 1936, pages 60-61. Describes the use of stainless steel (18-8), Ni and Ni alloys (Monel) for equipment for processing. Stainless steel is preferred for fruit and acid products and Ni or Ni alloys for brine. Specifications are given for the construction of plain and jacketed tanks and kettles. IW (14)

How to Select Electric Heating Alloys. F. P. Peters. *Product Engineering,* Vol. 7, Jan. 1936, pages 19-21. Electric resistance alloys for heating purposes must possess high melting point, resistance to oxidation, resistance to growth, low cost, strength at elevated temperature, high electrical resistance, and low temperature coefficient of expansion. Properties of the following metals and alloys are tabulated: Mo, Pt, 80Pt 20Rh, 72Fe 20Cr 5Al 3Co, 68Fe 27Cr 5Al, 80Fe 15Cr 5Al, 80Ni 20Cr, 60Ni 16Cr 24Fe, 30Ni 20Cr 50Fe, 45Ni 55Cu, 25Ni 75Fe, 18Ni 60Cu 22Zn, ranging in melting temperatures from 4750° to 2000° F. Ha (14)

Metals in Airplanes. *Engineering & Mining Journal,* Vol. 136, Nov. 1935, page 557. Metals and alloys employed in airplane construction are listed. WHB (14)

Arc Is Discharged in Line Form in Contactor of New Design. *Steel,* Vol. 97, Sept. 23, 1935, pages 44, 46. Contactor described utilizes Al alloys in moving parts and high permeability, rolled steel armature plates and core in magnetic circuit. Contacts are cold formed of pure Cu, hardened by a special process. Nitralloy is used for bearing pins, bushings, and main contactor arm. Ag is used for stationary control circuit contacts on panel and for control circuit contacts carried on a P-bronze, double-break bridge. MS (14)

Manufacture of Fare Boxes Provides Outlet for 150 Tons of Steel Annually. *Steel,* Vol. 97, Dec. 23, 1935, page 38. Describes several types of fare boxes used on street-cars and buses. Steel, Al, and brass are chief metals used in their construction. MS (14)

■ 14a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Makes Large Lantern for Boulder Dam of Aluminum Castings. *Foundry,* Vol. 63, Oct. 1935, page 51. Describes lantern made of Al by the Pacific Brass Foundry. Castings are made from Al-Si alloy, similar to S.A.E. No. 35 or Aluminum Co. of America No. 43. Only new metal was used in the mixture to conform to stringent government regulations. Item of interest is the construction of the flasks, the ends of which were made to conform to irregular parting line of particular piece, resulting in one side of drag and cope being 8″ higher or lower than opposite side. VSP (14a)

Copper Channel Bus-Bars. G. W. Preston. *Electrical Review,* Vol. 118, Jan. 31, 1936, page 160. Describes use at Boulder Dam. Each phase conductor of bus-bars is composed of 2-6″ Cu channels, held together to form a hollow square by means of Cu clamps and bolts. Clamps are made from extruded sections and are fixed at short intervals along the channels. Bars and their insulators support surrounding housing. Inclosure and inter-phase barriers are constructed of ⅛″ thick Cu sheet and all fittings, nuts, bolts, and structural members are made entirely of Cu or its alloys. Required 112 tons of Cu and alloys. MS (14a)

The Electrochemical Behavior of Lead, Lead-Antimony, and Lead-Calcium Alloys in Storage Cells. H. E. Haring & U. B. Thomas. *Paper, Electrochemical Society,* Oct. 1935, pages 163-177. In the usual Pb-Sb grids Sb is leached out of the positive electrode and deposited on the negative, causing local action and self-discharge. Grids made from a Pb-Ca alloy (.1% Ca or less) do not have this defect since Ca is electronegative to Pb. In addition the Pb-Ca alloy does not sulphate so rapidly and retains its charge longer. GBH (14a)

Some Physical and Metallurgical Properties of Lead Calcium Alloys for Storage Cell Grids and Plates. E. E. Schumacher & G. S. Phipps. *Paper, Electrochemical Society,* Oct. 1935, pages 155-162. A Pb-Ca alloy containing .10% Ca has a tensile strength of 8,000 lbs./in.^{2}, which is comparable to Pb-Sb alloy now used. Pb-Ca alloy requires aging for a week at room temperature and heat treatment at 100° C. for 18 hrs. Material cost of these alloys, however, will be lower than that of Pb-Sb alloys. GBH (14a)

Sweep-Float Made Portable Through Use of Aluminum Alloy. Vernon H. Donaldson. *Engineering-News-Record,* Vol. 116, Jan. 9, 1936, pages 50-51. Sweep-float for quick checking of depths in navigable channels was built of Al in small units so that the apparatus could be taken apart and loaded on a truck for movement from port to port. CBJ (14a)

Recent Developments in the Manufacture and Applications of Magnesium and Magnesium Alloys. W. C. Devereux. *Metallurgia,* Vol. 13, Dec. 1935, pages 47-49. It is reported that Mg is now produced in England and in Austria by reduction of MgO with C in an arc furnace in H atmosphere. The crude metal is purified by distillation in an inert atmosphere. Casting and working of Mg are described. Properties of alloys are given and uses of alloys, principally in aircrafts, are mentioned. JLG (14a)

Bearing Bronzes. Published by Copper Development Association, London, 1935. Boards, 4 x 7 inches, 32 pages.

This was issued as C.D.A. publication No. 15 and discusses: requirements of a bearing metal; range of British bearing bronzes; properties of Cu-Sn bearing bronzes; bearing brasses; Cu-Pb bearing alloys; typical bearing bronzes, etc. Richard Rimbach (14a) -B-

Bearing Metals. R. T. Rolfe. *Metal Industry,* London, Vol. 46, June 28, 1935, pages 691-694; Vol. 47, July 12, 1935, pages 33-36; July 19, 1935, pages 59-62; July 26, 1935, pages 85-88; Aug. 2, 1935, pages 109-111; Aug. 9, 1935, pages 135-138. A slightly condensed version of a paper presented to the Midland Metallurgical Societies. In spite of the importance of bearings in engineering, the average engineer seems to know but little about the composition and behavior of the materials used in bearings and about lubrication in general. The author endeavors to indicate in which directions more information may be obtained. Lubrication is discussed in a broad general manner. Little information is available relative to variations in operating conditions of bearings in service due to the difficulties encountered in the determination and interpretation of data. Most bearing failures are attributed to metallic contacts caused by failure of the oil system to function properly. The requirements of good bearing metals discussed are: (1) good melting and casting properties, (2) high compressive and tensile strength under service conditions, (3) sufficient plasticity to accommodate inequalities in alignment, (4) a low coefficient of friction, (5) a high thermal conductivity, (6) a high resistance to wear. A survey is made of the materials used commercially today as bearings and it is pointed out that cost is a major factor. The constituents of the Sn-base alloys are discussed. The properties of a number of bearings, gradually changing from the Sn-base to the Pb-base are tabulated with specific recommendations indicating where each is superior. In a detailed comparison between Sn-base and Pb-base bearing alloys, the author discusses physical properties, rate of wear, conditions for lining bearings, commercial practice and practical procedure in lining, preparation before tinning and the tinning operation, lining and some specific methods used in lining. The advantages of the centrifugal lining process are indicated and the process is briefly described. Specific examples are given of bearings that failed in service and reasons why these failures are ascribed to certain factors are indicated. Among the Pb-base alloys considered are the Pb-Sb alloys and the Pb-alkaline earth alloys. The latter were developed due to the scarcity of Sn during the War. The excellent physical properties obtained with these alloys should make them economical substitutes for the expensive Sn-base alloys but the oxidation during melting and the removal of the hardening constituents as dross, will probably prevent such a substitution in normal times. Among the Cu-Sn alloys considered are admiralty gunmetal and the phosphor-bronzes. The constitutional diagram of the former is discussed, methods for obtaining the δ-constituent are indicated, some commercial applications are cited, and it is emphasized that to insure satisfactory operation of bearings of this alloy they must be accurately bored and properly aligned. Cast material is superior to hot-rolled. The advantages of phosphor-bronzes over gunmetal are pointed out and commercial applications are noted. Best physical properties are obtained when the alloy is centrifugally cast. Leaded bronzes are compared with the Cu-Pb alloys. Pb-segregation is encountered in both types of alloys but under suitable conditions 30% Pb can be used in Cu-Pb alloys without undue segregation. The additions of small amounts of S and Si-Zr have entirely prevented segregation in Cu-Pb alloys containing 40% Pb. After comparing mechanical quality, hardness and frictional quality, thermal quality, and rate of wear of leaded bronzes and Cu-Pb alloys with white metals, the author states that the straight Cu-Pb alloys are replacing the white metals where service reliability is of major importance. Self-lubricating alloys such as "Genelite," manufactured by the General Electric Co., and "Oilite," produced by the Manganese Brass and Bronze Co., are briefly discussed. The patented processes of the General Motors Co. for the manufacture of similar alloys are outlined. Included among the non-metallic bearing materials are Lignum Vitae, rubber and plastic or synthetic resins. The latter have just recently come into use as materials for bearings. Little information is, as yet, available for these materials but it is claimed that as bearings for rolling mills they are superior to either cast Fe or gunmetal. The physical properties of a number of the alloys discussed are presented in tabular form and the articles are illustrated by a number of micrographs. HBG (14a)

■ 14b. Ferrous ■

M. GENSAMER, SECTION EDITOR

Selection of Die Steels for Plastic Molding. *Steel,* Vol. 97, Nov. 18, 1935, pages 30-33. Principal qualities desired in die steels for plastic molding are resistance to abrasive wear and corrosion, workability, proper surfacing, and ability of core to stand up under repeated applications of pressure. There is no unanimity as to what is the most suitable all-around steel. In general, tool-steel, machine, low-C alloy, and nitralloy steels are used for this purpose. Advantages and disadvantages of each of these groups and of Cr plating molds are presented. Recently introduced steel for molding Bakelite is "Bakadie," a Ni-Mo steel with low-C. It takes a high mirror finish, has a tough core, and after heat treatment shows a surface hardness of 63-65 Rockwell. Heat treatment involves normalizing at 1150° F. between hobbing operations and cooling in still air. Die should be held for 1 hr./in.^{2} cross-section. It should be carburized at 1600°-1650° F., cooled in pot, reheated to 1475°-1550° F., quenched in oil, and drawn at 300°-400° F. Mold used in production of Plaskon housing for Toledo scale weighs 7 tons and required special methods of handling during treatment to avoid distortion, cracking, or nicking. Parts were packed with carburizer in specially constructed boxes, which were loaded into a gas-fired furnace at 1120° F. Temperature was raised in 10 hrs. to 1660° F. and held for 20 hrs. Parts were furnace cooled in 4 hrs. to 1000° F. at which they were held for 1 hr., slowly heated to 1500° F. and held for 9 hrs., quenched in oil to 400° F., cooled in air, drawn in an electric furnace held at 425° F. for 16 hrs., and air cooled to room temperature. MS (14b)

Cold Heading Dies and Die Steels. J. C. Alexander. *Mechanical World & Engineering Record,* Vol. 48, Nov. 1, 1935, pages 423-424. Cold-heading machines are now ahead of tool steels and die developments with the result that modern machines cannot always be run at maximum speed. The problem is discussed and an explanation is given of the best ways of making use of available materials. WH (14b)

Steels for Ball Bearings. B. M. Suslov. *Metal Progress,* Vol. 28, Dec. 1935, page 51. Data on steel compositions and production of ball and roller bearings in U.S.S.R. WLC (14b)

Metallurgical Developments and the Mining Industry. L. Sanderson. *Canadian Mining Journal,* Vol. 56, Nov. 1935, pages 526-527. A brief review of metallurgical developments during the past year. Mn steels, the welding of high-Mn steels, highly-alloyed cast irons, alloy steels, stainless steels and wires, Ni-Mo, Mn-Mo and special C steels are discussed. WHB (14b)

Some Mechanical and Metallurgical Aspects of Present-day Oil-production Equipment. Albert G. Zima. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 399-412. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 516R/2. (14b)

The Qualities, Characteristics, and Uses of Steels. A. C. Harris. *Iron & Coal Trades Review,* Vol. 131, Nov. 29, 1935, pages 905-906. The various types of steel made in the open-hearth process used for rails, wires, structural and other industrial purposes, and the special requirements for certain purposes such as aircraft and automobile engineering are reviewed exhaustively. Ha (14b)

Iron and Steel. *Food Industries,* Vol. 7, Dec. 1935, page 576. Fe and steel in contact with foods should be protected by a non-corrosive coating. Cast Fe may be used sometimes without a protective coating because of its natural Si-Fe alloy surface but machined or ground surfaces are not so protected. Fe and steel continue to be chief metallic materials of construction for the food processor because of low cost, strength, ease of fabrication and availability. BWG (14b)

Material Problem of High-grade Rails (Zur Baustofffrage hochwertiger Schienen). Berchtenbreiter. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 90, July 1, 1935, pages 232-235. Discusses tensile strength, impact strength, wear resistance and cleanliness of rail steel. States that higher Mn and Si contents with low additions of Cr and Cu furnish tough rails of medium tensile strength but with considerably increased resistance to abrasion. Austenitic Mn steels become sufficiently surface hardened in service. Cleaner steels are obtained in electrical furnaces. Attention is called to compound rails whose rail surface has a hardness of 330-400 Brinell, while web and lower flange show 120-140 Brinell. Surface hardening by heat treatment followed by quenching, welding and built-up welding of rails are dealt with. EF (14b)

The Use of Alloy Steels in Mining Work. L. Lahoussay. *Iron & Coal Trades Review,* Vol. 131, Dec. 6, 1935, page 941. A review of the types of steel used and economies obtained in using these steels of greater strength in ropes and mine equipment, particularly in French mines. Ha (14b)

Reinforced Concrete. Report of the Building Research Board. *Iron & Coal Trades Review,* Vol. 131, Nov. 22, 1935, page 870. Comparative tests for various steels in reinforced concrete are described. Results showed that with regard to deflection and cracking due to strain, concrete reinforced with special alloy steels behaves in much the same way as with ordinary mild steel. At 12 tons/in.^{2} the deflections of the beams with special steel reinforcement were about 40-50% greater than the deflections of beams reinforced with ordinary steel at 9 tons/in.^{2} A marked increase in ultimate strength was, however, observed for the special steel reinforcement. The factor of safety was 2.67 at 12 tons against 2.33 for the ordinary steel at 8 tons/in.^{2} The tests are described and discussed in detail. Ha (14b)

Large Uses of Steel in Small Ways. No. 295. Skylight Guards. *Steel,* Vol. 97, Sept. 16, 1935, page 31. Manufacture of skylight guards requires annually about 100 tons of steel, consisting almost entirely of wire, rods and shapes. MS (14b)

Metal Replaces Glass in Radio Tubes. *Metal Progress,* Vol. 28, Dec. 1935, pages 32-37. Describes the development of metal parts in the internal structure of radio tubes and the final development of metal envelopes to replace glass. WLC (14b)

Large Uses of Steel in Small Ways. No. 296. Barber Shop Equipment. *Steel,* Vol. 97, Sept. 30, 1935, page 36. Modern barber and beauty shop furnishings represent an important outlet for Fe and steel much of which is porcelain enameled and Cr plated. About 90% of the weight of a barber chair is cast Fe. It is estimated that before the depression, more than 3000 tons of Fe and steel were consumed annually in manufacture of barber chairs. MS (14b)

Large Uses of Steel in Small Ways. No. 294. Wire Tying Machines. *Steel,* Vol. 97, Sept. 2, 1935, page 58. Machines for tying and reinforcing various articles, bundles, and cases are made in various sizes. They are made of castings, forgings, and rolled steel parts. About 6000 tons of steel wire are consumed annually for tying. MS (14b)

One-Piece Cast Steel Decks on Air Compressors Withstand Severe Service. *Steel,* Vol. 97, Sept. 2, 1935, pages 53-54. One-piece steel castings made from a special grade of low-C, unannealed steel have been found most satisfactory for withstanding shock and vibration and eliminating distortion of frames. MS (14b)

Rotary Cutter Has Liquid Seals and Saves Power by Using Roller Bearings. *Steel,* Vol. 97, Sept. 2, 1935, page 42. Describes improved cutter, utilizing steel and gray-Fe and semi-steel castings in its construction. Knives are made with special alloy soft steel backing, with high-speed steel inlays, welded together under hydraulic pressure. MS (14b)

Frameless Steel Building Erected to House Unattended Telephone Exchange. *Steel,* Vol. 97, Sept. 16, 1935, pages 38-39. Describes building constructed of steel sheets. Outer walls are porcelain enameled. Sections are shop fabricated. MS (14b)

Large Uses of Steel in Small Ways. No. 300. Car Movers. *Steel,* Vol. 97, Nov. 25, 1935, page 42. Shoe, socket, and saddle toggle of car mover illustrated are electric furnace, normalized steel castings containing 0.25-0.35% C, 0.60-0.80% Mn, and less than 0.04% in both P and S. Spur plate is of malleable Fe. Bolts, nuts, and pin are of mild steel. Roller is a steel bushing. Spurs are of tool-steel. MS (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Metallurgical Researches of the National Physical and Technical Institute for 1934 (Aus den metallkundlichen Arbeiten der Physikalisch-Technischen Reichsanstalt im Jahre 1934). A. Schulze. *Zeitschrift für Metallkunde,* Vol. 27, June 1935, pages 139-140. A progress report of investigations on the chemical and physical properties of metals and alloys, dealing especially with the preparation of high purity materials; magnetic, thermal, and elastic properties; low temperature work; and the development of special apparatus. GD (15)

Technical Progress Provides Stimulus for Modernization of Equipment. N. G. Symonds. *Steel,* Vol. 97, Sept. 23, 1935, pages 66, 68. Discusses promotion of modernization in the steel industry by more efficacious electrical devices and mechanical improvements, with examples of developments by Westinghouse Electric & Mfg. Co. These include an automatic circuit-breaker; an "electrical drive shaft" or synchro-tie; photo-electric tube control of motor-driven sheet catcher; Micarta bearings; and gear motor. MS (15)

French Tool Steels. Albert Portevin. *Metal Progress,* Vol. 28, Sept. 1935, page 61. Brief summary of compositions of commonly used tool steels of France. WLC (15)

This Apprentice System Was Depression-Proof. Franklin R. Hoadley. *Steel,* Vol. 97, Dec. 2, 1935, pages 17-18. Paper read before National Founders' Association. Describes system of Farrel-Birmingham Co., Ansonia, Conn., for training foundry apprentices. Features include giving boy a job at 40-45 cents per hr.; guaranteeing him steady work, and regular wage increases during apprenticeship; training him in foundry practice; and offering him an opportunity for further education and advancement. MS (15)

15a. Economic

The World's Gold Resources. A. Knopf. *Scientific Monthly,* Vol. 42, Jan. 1936, pages 62-67. Present state of production, mode of occurrence of Au and the resources of the U. S. are reviewed. The Au resources of the world are very large but they cannot be measured with any approach to accuracy. Au in sea water is contained in the ratio of about 1 to 10^8 so that no commercial possibility of exploiting it can be foreseen; the deep-sea sediments, however, will very likely be rich in Au. 6 references. Ha (15a)

Recent Trends in British Iron and Steel Production. K. R. Binks. *Metallurgia,* Vol. 13, Dec. 1935, pages 67-68. Production of steel ingots in 1935 approached prosperity levels. The average output per month was 809,712 tons in 1917, 804,600 tons in 1929, and 802,255 tons in 1935. It is concluded that the causes leading to such expansion in output cannot be called abnormal, but are the result of general increase in national prosperity, protection of home markets from outside influences, and a rational policy for the regulation of the steel industry as a whole. JLG (15a)

How Can the Metal Founder Increase His Competitiveness? (Wie kann der Metallgiesser seine Wettbewerbsfähigkeit erhöhen?). Erich Becker. *Giesserei,* Vol. 22, Nov. 22, 1935, pages 586-588. The various methods of producing metallic parts, by casting, punching, turning and pressing are briefly compared and casting methods discussed at greater length as casting has the least and cheapest waste and therefore the least economical loss. Hot-pressing is sometimes advantageous especially if later the parts have to be polished. Dies for pressing should be of a composition Ni-Cr-cast Fe: 2.7-3% total C, 0.7-0.8% Si, 0.6-0.9% Mn, 2-2.5% Ni, 0.9-1.1% Cr; P should not exceed 0.2% and S 0.12%; heated to 790° C., quenched in water or oil, and annealed in boiling water to release interior stresses. Polishing methods are discussed as to their economical preferences. Ha (15a)

The Aluminum Industry. Prospects in the World Markets. Richard Flint. *Metal Industry,* London, Vol. 47, July 26, 1935, pages 79-80. The international aluminum industry has successfully endeavored to balance the world supply and demand by regulation of production and storage of the surplus output. At present Japan, Russia, and Sweden are in a state of transition from buyers to producers and British India is a new possible source. The activities in Japan and Russia, and the consequences of transition are discussed. The percentages imported and exported. the results of this transition and its effect on the domestic market are considered. HBG (15a)

The World's Metal Production and Consumption in 1934. *Engineer,* Vol. 160, Sept. 6, 1935, pages 249-250. Gives figures collected and issued annually by the Metall-Gesellschaft of Frankfurt-on-Main, Germany. From 1929 to 1932 metal production exceeded the consumption but during 1933 and 1934 the consumption increased and exceeded the production. Figures are given of world production and consumption of Pb, Cu, Zn, Sn and Al from 1929 to 1934 inclusive. American production has fallen behind the average of the whole world while that of Continental Europe has been increasing due to the expansion of the Dutch and Belgian industries from their colonial ores. Production in the British Empire of Pb, Cu and Zn increased during the past year. LFM (15a)

Dumping and the Pretoria Steel Works. *Engineer,* Vol. 160, Sept. 20, 1935, page 304. Comments on a recent complaint made by the South Africa Iron and Steel Industrial Corporation. The Pretoria works of the company which started last year have been forced to close their rolling mills for 2 weeks due to dumping of iron and steel products in the Union. It is expected that the Government will intervene in some manner to protect them although at the present time the company has an advantage over imported products through a saving of sea freight and coast charges. LFM (15a)

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Russian Steel Exports. *Engineer,* Vol. 160, Sept. 20, 1935, page 302. Russia is exporting foundry iron to certain European countries and steel to Turkey. Production of Soviet pig iron in 1934 was 10.5 million tons and in 1933, 7.2 millions; 9.6 million tons of steel in 1934 and 6.9 million tons in 1933; 6.69 million tons of rolled products in 1934 and 4.48 million tons in 1933. The plan for 1935 is to produce 12.5 million tons of pig iron, 11.8 million tons of steel, 8.65 million tons of rolled products. Building and construction plans which include the entire rebuilding of the city of Moscow and extension and renewal of railways are expected to absorb the rolled products. Foreign markets are being sought for the pig iron and steel. It is thought that Russia may join the Continental Steel Cartel to secure a favorable export quota. LFM (15a)

Age of Alloys Is Upsetting Steel as a Barometer. KENNETH B. LEWIS. *Steel,* Vol. 97, Nov. 11, 1935, pages 17-18. Technical developments in the steel industry during the past 20 years, such as electric melting, alloy steels, fusion welding, and improved protective coatings, have shifted emphasis from quantity to quality. These advances have affected production curves much more than have wars, depressions, and political conditions. During the active phase of such revolution ordinary charts of steel production no longer have any clear significance as indexes of trade activity or of changes in material well-being. MS (15a)

The Progress of Magnesium Industry in Japan. S. IMATOMI. *Scientific Papers Institute of Physical & Chemical Research, Tokyo,* Vol. 27/28, Sept. 1935, pages 57-67. In English. Discusses the subject under the following headings: (1) Introduction, (2) history of the Mg industry in Japan, (3) raw materials, (4) comparison of Mg raw materials in the world, (5) methods of manufacturing Mg, (6) Mg alloys, (7) casting method and anti-corrosion methods, (8) Japan's Mg industry in future. The great supply of raw materials in Japan compared with the rest of the world is stressed and hope is expressed that Japan will become the "largest Mg producer in the near future." Ways are pointed out which will result in a lowering of present production costs. WH (15a)

■ 15b. Historical ■

Melts Iron In Air Furnaces. *Foundry,* July 1935, pages 18-20, 44, 47; **Hardens Steel Roll Surfaces.** Aug. 1935, pages 36-37, 77-78; **Makes Corrugated Slag Ladles.** Sept. 1935, pages 38-39, 96, 99. Describes the work of Mackintosh-Hemphill Co., Pittsburgh for over 130 years. During the Civil War this company produced cast cannons and also some of the earliest rolls for brass sheets. Certain present day small hard chilled Fe rolls used for special purposes are cast from cupola melted metal. Other cast Fe rolls are cast from Fe melted in air furnaces. Melting procedure and charges for chilled Fe rolls are given. Hardening of rolls is accomplished by a torch and spray method. Corrugated and smooth rolls are made. Following compositions are used for the rolls: Smooth—1.00% C, 1.50% Ni, 0.35% Mo, 1.00% Cr, 0.75% Mn. Corrugated—0.45 % C, 0.35% Mo and 1.25% Mn. These rolls may be used where strength and wear requirements are strict. Slag ladles are made in various sizes. Describes the process. VSP (15b)

Origins of Our Modern Guns. ROGERS BIRNIE. *Army Ordnance,* Vol. 16, Nov.-Dec. 1935, pages 147-153. A review of the period from 1880 to 1890 when steel was adopted for the manufacture of cannon. Early gun steels were oil quenched and then annealed to obtain metal free from internal stresses. DJM (15b)

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CURRENT NEWS ITEMS

The Chemistry of Metals

A symposium on "The Chemistry of Metals" was the feature of the April meeting at the Chemists' Club in New York of the New York Section of the American Chemical Society. There were three speakers: Dr. John Johnston, director of the United States Steel Corp., Research Laboratory, Kearny, N. J., who spoke on "The Chemistry of the Ferrous Metals"; C. E. MacQuigg, metallurgist, Union Carbide & Carbon Research Laboratories, New York, whose subject was "The Chemistry of the Ferrous Alloys" and Prof. C. H. Mathewson, head of the metallurgical department of Yale University, New Haven, Conn., who discussed "The Chemistry of the Non-Ferrous Metals and Alloys." There was a large attendance.

Dr. Johnson emphasized the fact that researches on the chemistry of the blast furnace have shown that the efficiency of coke in the chemical reactions is about 80 per cent, a figure hardly likely to be improved upon. So far as low temperature reduction of ores is concerned, he said that the economical production of sponge iron in competition with scrap is not yet feasible. Discussing steel melting processes, he believes that it is possible to produce in the Bessemer converter as good steel as in the open-hearth, if it is efficiently and scientifically operated.

Bethlehem's New Motion Picture on Alloy Steel

The Bethlehem Steel Co. has announced the completion of a new talking motion picture entitled, "The Making of Alloy Steel." All of the various processes, beginning with the charging of the open-hearth furnace through to the loading of finished bars on freight cars, are shown in this picture. The picture very clearly depicts the care that must be taken at every stage in the making of alloy steel and also the checking and re-checking that is necessary throughout its development in order to assure that the steel will be made according to specifications.

The charging and tapping of the open-hearth, the making of various alloy and other additions to the metal, preparation of the molds, pouring of ingots, placing of hot-tops and other details are shown. From the soaking pits on through the blooming mill and the bar mills, the progress of the steel from ingot to bar is faithfully followed. Operations in the modern electric heat treating department at Bethlehem are shown, as well as many tests made during the progress of manufacture.

The picture shows all of these various operations, just as they occur in the ordinary routine of making alloy steel. The explanatory lecture on the sound track follows the various processes of manufacture and explains the results obtained in the case of many of the operations and treatments. It is a technical picture throughout and is intended primarily for technical audiences. It is a 16mm picture and takes 45 mins. to show.

Balanced Alloys Stressed at Moscow

The importance of balanced alloys in chromium and manganese steels was stressed by Dr. A. B. Kizel of Union Carbide and Carbon Research Laboratories, Inc., in a lecture recently delivered in Moscow, Russia, before the society for Science and Culture. Balanced alloy steels were defined as those that contain alloying elements and carbon so proportioned that the optimum combination of desired properties is obtained.

The first part of the address centered on low-alloy structural steels that are immediately usable in the as-rolled condition. The remainder of the talk was devoted largely to balanced high chromium-manganese stainless steels.

Earl C. Smith, chief metallurgist of **Republic Steel Corp.,** has announced the appointment of Muir L. Frey to the metallurgical staff with headquarters at the Republic plant in Buffalo. Mr. Frey comes to Republic from John Deere Tractor Co. in Waterloo, Iowa, where he has held the position of chief metallurgist for the past ten years.

Mellon Institute's Metallurgical Work

The report of the director, E. R. Weidlein, to the trustees of Mellon Institute, for the work of March 1, 1935, to March 1, 1936, while dealing chiefly with topics in industrial, organic and medical chemistry, contains a few items of metallurgical interest. Asbestos-protected metal, with the asbestos bonded onto galvanized steel by contact when the zinc coating is molten or plastic, is mentioned Some undescribed advances relating to drawing and processing of steel wire, and the development of a new alloy steel for razor blades, also undescribed, are also mentioned.

Some work is in progress relating to silicosis. Other projects of metallurgical interest relate to refractories. Cast, electrically fused refractories are under development. It has been found in work on other refractories that the emissivity of light-colored refractories decreases rapidly with increase in temperature above 400 deg. F., which is said to be of interest to electric furnace operators.

Ceramic Society's New Officers

At the annual meeting of the American Ceramic Society, held in Columbus recently, the following officers for 1936-1937 were elected: President, Francis C. Flint, chief chemist, Hazel-Atlas Glass Co., Zanesville, Ohio; vice-president, Robert B. Sosman, director of research, United States Steel Corp., Kearny, N. J.; treasurer, H. B. Henderson, H. B. Henderson Co., New Brighton, Pa.; past-presidents, J. M. McKinley, North American Refractories Co., Cleveland and W. Keith McAfee, Universal Sanitary Mfg. Co., New Castle, Pa.

New Name and Sales Plan for Askania

The business in automatic regulation, previously carried on by H. A. Brassert & Co. in the iron and steel industry and by the American Askania Corp. in other industries, has been united and placed in the hands of a newly organized company which is now known as the Askania Regulator Co. This change became effective the first week in March.

With the organization of the new Askania Regulator Co., all sales and manufacturing to all industries will be concentrated within the new organization. This change allows for sales simplification and better service to industry as a whole. The officers and the manufacturing plant of the new company remain the same as that of the old American Askania Corp., 1603 South Michigan Avenue, Chicago, Ill.

The new Askania company will continue to develop and manufacture automatic controls for iron and steel mills, power plants, chemical industries, paper mills, engine and turbine manufacturers, glass works and kindred process industries. Askania control regulates pressure, rate of flow, humidity, speed of rotation, draft, water level, air for combustion and any other condition that is measureable.

John M. Lessells Goes to M.I.T.

The appointment of John M. Lessells, consulting mechanical engineer, of Swarthmore, Pa., as associate professor of mechanical engineering at the Massachusetts Institute of Technology, has been announced. He will be occupied with teaching and research in the field of engineering materials.

The annual meeting of the **Electric Metal Makers Guild** will be held at the Hotel Onesto, Canton, Ohio, June 5 and 6, 1936. Technical Sessions are being arranged, and there is expected a full attendance of the membership.

Dr. Haig Solakian, chief metallurgist of the Geometric Tool Co., has accepted a position as research metallurgist with the **A. F. Holden Co.,** metallurgical engineers, New Haven, Conn. Dr. Solakian received his D.Sc. degree from the Massachusetts Institute of Technology.

F. Hall Hately, formerly development engineer for Whitehead Metal Products Co., New York, is now in the products development engineering department of Scovill Mfg. Co., Waterbury, Conn.

MANUFACTURERS' LITERATURE

Corrosion and Heat Resisting Stainless Steels

This company claims that it is unique in the respect that its materials are manufactured by special processes involving the direct reduction of chrome ore and providing a closer metallurgical control than has been obtainable heretofore. Type analyses of some standard grades are included in the colorful bulletin. Rustless Iron and Steel Corp., Baltimore, Md. (451)

Drop Forgings

This attractive booklet deals with the characteristics, qualities and uses of drop forgings. It contains valuable information for anyone interested in this subject. Drop Forging Association, Cleveland, O. (452)

Thermal Analyzer

A brochure describing laboratory furnace equipment designed to conduct grain size test, creep tests, thermocouple calibration, etc., and also for precision heat treatment, has been published by the Stanley P. Rockwell Co., Chicago, Ill. (453)

Hardening Control

Useful information regarding case hardening steel is contained in a booklet of the A. F. Holden Co., New Haven, Conn. (454)

Recirculating Furnace

A leaflet lists some of the outstanding features of the "Galvo" furnace as simplified control, even temperature, economical operation, greater heat transfer, indirect firing methods, quicker heating up and flexibility. It was designed to meet the needs of the galvanizing, tinplating and allied industries. F. C. Williams, Inc., Detroit, Mich. (455)

The Jetal Process

Simple immersion in an aqueous bath for about 5 minutes colors all grades of common iron or steel a brilliant and uniform jet black. It is claimed it does not alter dimensions of articles and cannot chip, scale, peel or discolor. Alrose Chemical Co., Providence, R. I. (456)

Heat and Corrosion Resistant Alloys Heated by Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (457)

MoTung High Speed Steel

An illustrated booklet devoted to the above, contains information under these divisions: working and treatment, surface protection, high heat temperatures, drawing temperatures, effect of treatment, etc. An index is included. Universal Steel Co., Bridgeville, Pa. and Cyclops Steel Co., Titusville, Pa. (458)

Hi-Steel

Information concerning chemical composition, physical properties and corrosion resistance of this steel is offered by the Inland Steel Company, Chicago, Ill. (459)

Controlled Grain Anodes

Seymour Nickel Anodes are homogeneous in grain structure, according to this bulletin. The various available shapes are illustrated and some useful data are given. The Seymour Manufacturing Co., Seymour, Conn. (460)

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat-treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (461)

Comparative Metal Melting Costs

A few of the subjects discussed in this colorful, illustrated booklet are: considerations governing selection of melting equipment; design and operation of types of melting equipment and melting costs. Campbell-Hausfeld Co., Harrison, O. (462)

Welding Rods

Hard-facing welding rods Nos. 459 and 217 are the subjects of an illustrated brochure. Hard surfacing can be done with these rods, either electrically or by the oxy-acetylene process to the great majority of ferrous welding parts. American Manganese Steel Co., Chicago Heights, Ill. (463)

Sand Testing Equipment

Catalog No. 103 is a handy reference book on sand testing and foundry control equipment and also contains sand data. It is looseleaf and additional sheets are sent upon request. Harry W. Dietert Co., Detroit, Mich. (464)

Forgings

Information on heat treated molybdenum-chromium-nickel steel forgings for heavy machinery is presented in an illustrated booklet of A. Finkl & Sons Co., Hartford, Conn. (465)

Degreasing

An attractive leaflet describes how modern equipment and solvents make degreasing and cleaning both inexpensive and efficient. Detroit Rex Products Co., Detroit, Mich. (466)

Insulating Firebrick

Bulletin R-2-D contains complete information of the five types of B & W insulating firebrick. A table of physical characteristics, curves of thermal conductivity and a list of applications are among the interesting items in this booklet. Babcock & Wilcox Co., New York, N. Y. (467)

Ramming Mix

An illustrated folder contains the statement that P. B. Sillimanite ramming mix can be used under the most severe operating conditions without deterioration. Recommended uses and instructions for installation are included among the data. Chas. Taylor Sons Co., Cincinnati, O. (468)

Thermometers

Catalog No. 1250 contains information covering liquid-filled, vapor-tension, and gas-filled recording, indicating and controlling thermometers. It also describes a new small-bulb gas-filled thermometer. It is in the form of an engineering reference book and contains about 500 temperature recording charts illustrated in full size. Bristol Co., Waterbury, Conn. (469)

Rust-Proofing

Bulletin No. 7-7 covers all phases of the Cromodine process for rust-proofing steel products. Illustrations of the results of both accelerated and actual service tests prove the value of Cromodizing. American Chemical Paint Co., Ambler Pa. (470)

Yoloy

A colorful bulletin summarizes the properties of the above alloy steel and lists the physical properties of two typical steels in the Yoloy series. It is claimed to be corrosion resistant and to have high tensile strength and high ductility. Youngstown Sheet and Tube Co., Youngstown, O. (471)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (472)

Optical Pyrometer

The Burrell optical pyrometer, a direct reading instrument originally designed for use with the Barrett fusion furnace and equally useful for other work requiring an optical pyrometer with a temperature range from 1500 to 3000 deg. F., is described and illustrated in a leaflet published by the Burrell Technical Supply Co., Pittsburgh, Pa. (473)

Molybdenum in Iron and Steel

An attractive brochure contains a summary of the part played by molybdenum in ferrous progress, and claims that a great saving in cost with no impairment in quality can be obtained by its use. The Climax Molybdenum Co., New York, N. Y. (474)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. It is claimed that this series represents the best straight cutting oils obtainable, at a price which meets and beats competition. E. F. Houghton & Co., Philadelphia, Pa. (475)

Heat Exchanger

Bulletin No. 173 describes the Duriron heat exchanger which is available in the company's corrosion-resisting alloys—Duriron, Durichlor, Durimet, Durco alloy steels and Alcumite. Illustrated. Duriron Co., Dayton, O. (476)

Coreless Induction Furnace

A colorful leaflet contains an explanation of the principle of operation and advantages to be obtained from the use of the Ajax-Northrup electric furnaces. Ajax Electrothermic Corp., Trenton, N. J. (477)

Standard Gas Fired Air Heaters

Publication SC-70 is devoted to these heaters which, it is claimed, are applicable to all low temperature heating operations which may be accomplished by the circulation of heated air and where contact of the material being heated with diluted products of combustion is not objectionable. Surface Combustion Corp., Toledo, O. (478)

Phosphor Bronze

A leaflet lists the sizes in which the company's twelve-inch stock bushing bars are now offered. The Phosphor-Bronze Smelting Co., Philadelphia, Pa. (479)

Centrifugal Castings

Advantages, analyses of metal—sizes of tubes, application, machining and welding and production facilities of these castings are discussed in an illustrated folder of The Duraloy Co., Pittsburgh, Pa. (480)

MANUFACTURERS' LITERATURE

Thermal and Sound Insulation

A catalog devoted to the above contains the statement that the Rockwool products discussed have been developed to the highest degree of efficiency to cope with temperatures from 400 deg. below zero to 2000 deg. F. and for every industrial and domestic requirement. Many of the different applications are illustrated and described. General Insulating and Manufacturing Co., Alexandria, Ind. (481)

Oxwelding Brass and Bronze

This booklet is divided into two main sections, the first devoted to the technique of fusion welding brass and bronze, the second is an illustrated section on the welding of commercial yellow brass pipe. Joint design and welding technique are discussed in detail. Linde Air Products Co., New York, N. Y. (482)

Resistance Wire

Catalog K deals with Hoskins Chromel and other electrical resistance wires. Tables, diagrams, technical data, comparison of wire gauges and much other useful information. Hoskins Mfg. Co., Detroit, Mich. (483)

Soldering Flux

The Eureka Soldering Flux Crystal, a dry, granulated product specially desirable for soldering on copper, brass, tin plate, sheet iron and galvanized ware is the subject of a colorful folder. Grasselli Chemical Co., Inc., Cleveland, O. (484)

Electric Ammonia Dissociators

May be used to replace hydrogen in practically all industrial applications, effecting a decided reduction in gas cost. Ajax Electric Co., Inc., Philadelphia, Pa. (485)

Torsion Impact Testing Machine

Bulletin No. 114 discusses the Carpenter machine whose operation is very simple and requires only one operator. Baldwin-Southwark Corp., Philadelphia, Pa. (486)

Weatherproof Line Wire

Publication GEA-2103 gives information on a new wire with varnished cambric and a weatherproof braid treated with U.R.C. compound, General Electric Co., Schenectady, N. Y. (487)

Grinding for the Railroad Shop

As grinding is the recognized means of obtaining accurate, close-fitting and long-wearing parts at minimum costs it is rapidly coming into more general use by the railroads according to an attractive pamphlet of the Norton Co., Worcester, Mass. (488)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (489)

Combination Impact Tester

This machine will make either izod, charpy, or tension tests quickly and accurately, and with minimum operator effort according to an illustrated pamphlet which is issued by the Riehle Testing Machine Div. of American Machine and Metals, Inc., East Moline, Ill. (490)

Granite City HS Grades 1 and 2

Information concerning the Granite City manganese high tensile steels can be obtained from the Granite City Steel Co., Granite City, Ill. (491)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-ray has now come to the fore as a tool of the testing laboratory. Kelly-Koett Mfg. Co., Inc., Covington, Ky. (492)

Brazing Alloy

Bulletin No. 5 advocates the use of "Sil-Fos" for joining brass, bronze, nickel, nickel silver, extruding brass and bronze, Monel metal and other non-ferrous metals and alloy fusing above 1300 deg. F. Handy & Harman, New York, N. Y. (493)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (494)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (495)

Phosphor Bronze

This attractive brochure illustrates ten of this company's mill processes, with descriptive captions, in the making of phosphor bronze. Some typical fabricated products are also shown. Miller Co., Meriden, Conn. (496)

Grinding Lubrication

Many facts about grinding solutions are given in this booklet. An outline for the selection of grinding wheels is one of the factors contributing to its usefulness. D. A. Stuart & Co., Chicago, Ill. (497)

Forgings

The story of this company's forgings is told in a well-illustrated booklet. Reference tables give helpful data. Heppenstall Company, Pittsburgh, Pa. (498)

Metal Stampings

A small lot stamping service without prohibitive die costs is the subject of an illustrated leaflet of the Dayton Rogers Mfg. Co., Minneapolis, Minn. (499)

Indium

The development, characteristics and chemical properties of this rare metal are featured in an illustrated leaflet. Grasselli Chemical Co., Inc., Cleveland, O. (500)

Atmos-Gas Producer

Bulletin No. 101.4 is devoted to the above, which produces a treated gas suitable for the bright annealing of steel without decarburization according to the manufacturers, with modifications suitable for bright annealing copper and brass. Illustrations. C. M. Kemp Mfg. Co., Baltimore, Md. (501)

Bearing Security

This leaflet lists the four essentials of a bearing metal and claims that Ajax Bull Bearing alloy embodies them. Ajax Metal Co., Philadelphia, Pa. (502)

Spencer Turbo-Compressors

This bulletin which has illustrations of the complete range of sizes of this equipment also contains: "Midget" Turbo for individual mounting, a single-stage line which effects new economies and Gas-Tight Turbos for acid and explosive gases. Spencer-Turbine Company, Hartford, Conn. (503)

Konik

Data on this steel's physical properties, corrosion resistance and working, are offered by the Continental Steel Corp., Kokomo, Ind. (504)

Potentiometer Controllers

Bulletin No. 202 covers the complete line of potentiometer and resistance thermometer controllers. A number of simplified wiring diagrams showing how an installation looks are included. Foxboro Company, Foxboro, Mass. (505)

Research Puts the Diatom to Work

This booklet discusses the history of the diatom from which Celite is made. The four main industrial services of Celite: high temperature insulation, a filter aid, mineral filler and workability agent in concrete are described. Illustrations. Johns-Manville, New York, N. Y. (506)

Sicromo Steel

High temperature data sheets containing full information on this steel have been issued by The Timken Steel & Tube Co., Canton, O. (507)

A. W. 70-90

This bulletin describes the new high-strength "70-90" steel in sheets and plates. An article on the engineering aspect of high-strength sheet steels is included. Alan Wood Steel Co., Conshohocken, Pa. (508)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections Available Forms and Shop Practice has been published by The Dow Chemical Co., Midland, Mich. (509)

Fire Clay Products

The various Goose Lake products and Therm-O-Flake, for high temperature insulation are briefly described in a leaflet from the Illinois Clay Products Co., Joliet, Ill. (510)

Seamless Flexible Tubing

Bulletin 1936-1 contains the statement that American tubing is the most reliable type of flexible metal conveyor obtainable for services where absolute, 100 per cent tightness is essential. American Brass Company, Waterbury, Conn. (511)

Convected Air Tempering Furnaces Heated by Gas

Bulletin No. 40 concerns these furnaces which use the principle of mechanical convection to the maximum by incorporating in the design a patented rotary fan to drive the heated air downward with pressure and great velocity, in and around through the parts to be processed. Despatch Oven Company, Minneapolis, Minn. (512)

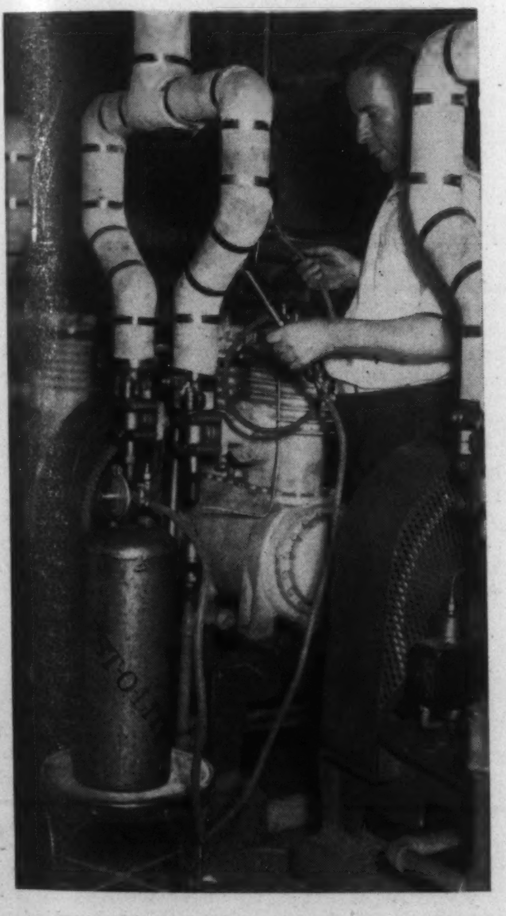
NEW EQUIPMENT AND MATERIALS

Halide Leak Detector for Refrigerant Gases

During recent years there has been a continued growth in the use of non-combustible halide gases as refrigerants. The fact that these gases are relatively odorless, tasteless, and colorless renders it necessary to have a quick and sure method of locating leaks while cooling units are being installed and later during servicing. Such a device, known as the "Prest-O-Lite Halide Leak Detector," has been developed by The Linde Air Products Co., 30 East 42nd St., New York.

The Halide Leak Detector consists of a regular Prest-O-Lite needle valve torch handle assembly, a burner which includes a suction nipple for attaching a rubber hose, and a chimney with a copper reaction plate. The rapid flow of acetylene through the burner causes a suction which draws in any refrigerant gas near the open end of the suction tube.

To operate the detector, the flame is first adjusted so that the top of the outside cone is level with or slightly above the chimney of the detector. The open end of the suction tube is used to explore around those places where a leak might occur. Any halide refrigerant gas drawn into the burner is decomposed with the formation of free acids. These acids, coming into contact with the hot copper reaction plate cause instant color response in the flame. Visible color indication of the smallest concentration of refrigerant gas by a green-tinted flame is given by the Prest-O-Lite Halide Leak Detector. When a large amount is present, the flame assumes an intense violet color. After the source of the leak has been passed, the flame clears almost instantly.

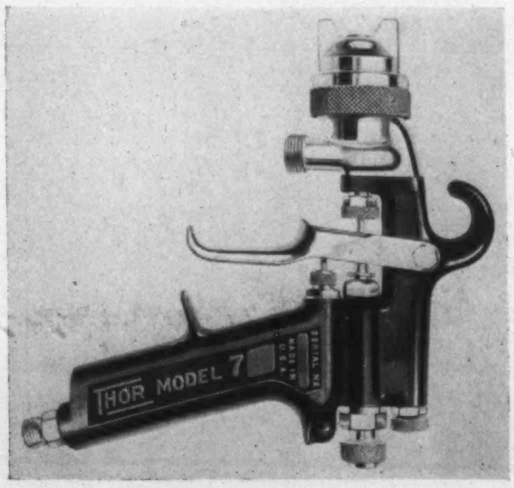

The Prest-O-Lite Halide Leak Detector affords a simple method of locating halide gas leaks, even in difficultly accessible places.

The two-color variation of flame gives visible indication of the amount of refrigerant gas present. If there is a considerable amount of refrigerant gas in the surrounding atmosphere, the leak can be located by the variation in the intensity of the color of the flame.

The Prest-O-Lite Halide Leak Detector is a simple, positive, supersensitive device which saves time in locating leaks, avoids waste of refrigerant gas and costly equipment shutdowns, and provides a sure method for determining the presence of these gases in the atmosphere.

A Fast Production Spray Gun

Greater speed, less air consumption, perfect atomization—these are some of the improvements which are causing Binks new "Thor Model 7 Spray Gun" to be hailed as one of the greatest engineering triumphs in spray painting history, says the Binks Mfg. Co., 3114 Carroll Ave., Chicago. The Thor Model 7 has been skillfully engineered after giving practical consideration to all phases and problems of the spray gun users of this country. It includes the suggestions of engineers of some of the country's largest industries, where smart finishing must be obtained at the lowest possible cost. A departure from all the other spray guns is the introduction of color into the gun body which is durable drop forged aluminum with a black electrolytic coating for surface protection.



A Filler for Cash Iron

A new product has recently been placed on the market for the porcelain enamel industry called "E-6 Cast Iron Filler." This filler is manufactured by the Porcelain Enamel & Mfg. Co., Baltimore, and it receives that same strict supervision that the "Pemco" staff of technicians has always adhered to in the manufacture of its frits and oxides.

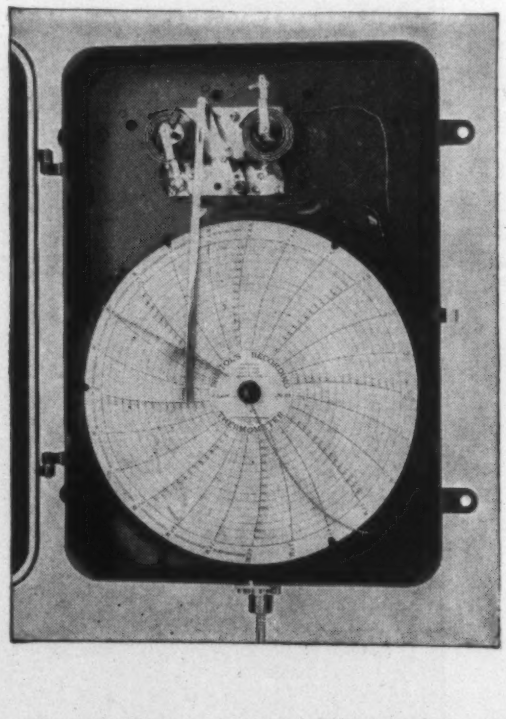
The scientific treatment that E-6 Cast Iron Filler receives makes it the most formative filler on the market today. If used carefully, it will prove to be very hard, almost making itself part of the iron, thereby, assuring the user that this filler will, no doubt, save him many bad castings. While not only saving many dollars by reducing his scrap pile, this filler will help the manufacturer to keep his production at a steady rate, instead of being held up by bad castings, says the company.

A Small-Bulb Gas-Filled Thermometer

An accurate gas-filled recording thermometer, having a small temperature-sensitive bulb for long lengths of connecting tubing, has for many years been the dream of every instrument engineer. Such a thermometer, Bristol's "Small-Bulb Gas-Filled Thermometer," has at last been successfully developed. It is offered for measuring temperatures between —60 deg. F. and 1000 deg. F., where tubing lengths as long as 100 ft. and even longer under certain conditions, are required by the application.

This instrument has all the features that have made Bristol's gas-filled thermometers the choice of engineers in every industry for over 40 years. It is extremely accurate under all conditions of temperature both along the tubing and in the case; it responds quickly to rapidly fluctuating temperatures at the bulb; and it records on a uniformly graduated chart.

The Small-Bulb Gas-Filled Thermometer consists of a rectangular case in which there are mounted two Class 111 measuring elements, connected through a compensating mechanism. Two capillary tubes, filled with the same gas, run from each element through one armor tube to the sensitive portion of the bulb. Only one capillary tube is connected to the temperature-sensitive bulb. The other is closed at the bulb end. Both capillary tubes, being adjacent, are subjected to the same temperature changes. Through the compensating mechanism, the tube and element not connected to the bulb correct for temperature changes along the connecting tube and in the case. In other words the tube and element not connected to the bulb produce a balancing action which exactly offsets the effect of temperature variations along the tube and around the measuring element connected to the bulb.



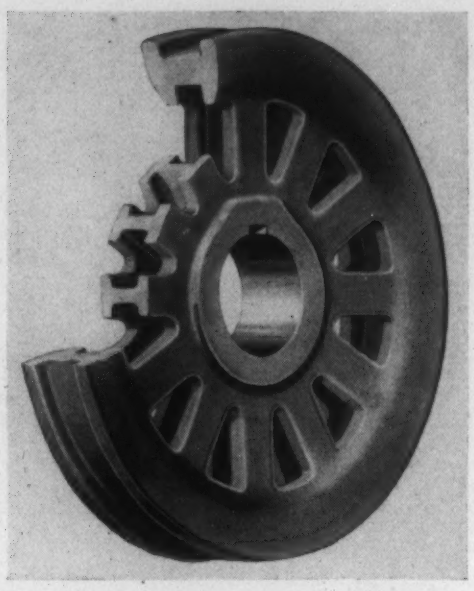
Lengths of tubing up to 100 feet and even longer under certain conditions can be furnished with small size bulbs.

Small-Bulb Class 111 Thermometers are offered with one or two pens in the 12-inch chart size; and with one pen only in the 8-inch chart size.

"Double-Wall" Crane Wheels

Rapid depreciation of ordinary traveling crane track wheels was the reason, many years ago, for the wide adoption of cast, heat-treated, austenitic manganese steel wheels for the heaviest and most abusive service. They have been employed with general satisfaction by steel mills, heavy machinery builders, railroad locomotive shops and the like, for at least 25 yr. Even when made in the single web conventional type, manganese steel crane wheels have shown superior economy and much longer than ordinary service life. The tough, ductile, work-hardening metal insures largely against rapid wear, surface cracking, and flat spots on the treads; and breaking of the flanges, or the web at flange or hub, has always been rare.

To obtain full advantage of these well-known characteristics of 13 per cent manganese steel, and to eliminate entirely the possible breakage of the web, "Amsco" engineers have designed the double wall crane wheel illustrated. The walls are continuous with the flanges, giving them a strong but elastic support and high resistance to side thrusts. The walls are integrally tied together with internal cross-spokes. Metal sections are equalized, making possible, in manganese steel foundry practice, a perfect heat treatment, resulting in the maximum toughness in the steel.

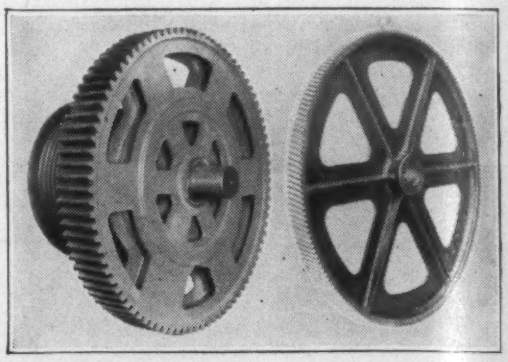


The inherent structural strength of the new double wall design, combined with the acknowledged toughness, strength and wear-resistance of manganese steel, makes these wheels highly economical in all traveling crane service, and particularly under the heaviest, most abusive and most abrasive conditions. "Amsco Double Wall" manganese steel crane wheels are made in all diameters, for all cranes, with hub lengths, bores and other optional dimensions to suit the user's requirements. A dimension and data sheet is available to those interested in this new product from the American Manganese Steel Co., Chicago Heights, Ill.

Welding for Crane Gears

The Harnischfeger Corp. of Milwaukee, a leading builder of electric overhead traveling cranes, has recently developed a new means of fabricating gears through the use of welding with rolled steel. Lighter weight with greater resistance to wear and strain is claimed.

Illustrated herewith are two types of gears with helical and spur cut teeth showing how these gears are built up with arms or webs of rolled steel, reinforced with gear bands welded integrally. The entire unit is normalized to provide the greatest possible strength.



Through this type of construction, all danger of casting flaws is eliminated. In addition, there is the advantage of being able to select special steels for members which are subject to high stresses. Easier replacements able on request.

A Light Hoist Called "Zip-Lift"

An entirely new line of electric hoists, known as the "Zip-Lifts" with capacity ratings from 250 to 500 lbs., is announced by the Harnischfeger Corp. of Milwaukee.

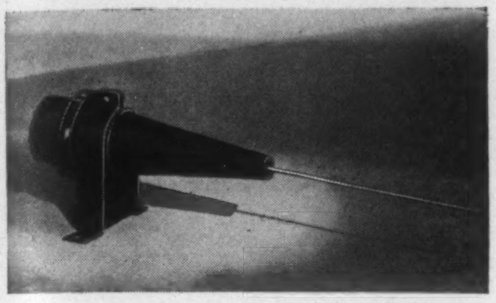
Designed primarily for "spot handling" work in machine shop, welderies, storage booths, foundries, etc., these units are of all welded construction and are exceptionally light, the quarter-ton model weighing only 100 lbs. With a ball bearing motor especially designed for hoisting service and smooth operation through a simplified planetary gear train which is fully enclosed and running in oil, the "Zip-Lifts" have hoisting speeds up to 32 ft. per min. and are controlled either by push button or pendant rope. To simplify installations, all complicated wiring has been eliminated so that for hook, trolley or jib crane service they need only be hooked up and plugged in like the average electric appliance.

Positive safety is assured with weight-type limit switch, solenoid dry disc motor brake and ratchet and roller type mechanical brake. Standard units are furnished with or without trolley.

For the Full Range
Of
HEAT TREATING
TEMPERATURES
To High Temperature of
2400° Fahrenheit
Use
Hevi Duty Furnaces
With
Smith Alloy 10
Metallic Electric Resistors
Gas Curtain Atmosphere Control
(Licensed under C. I. Hayes Patents)
•
FOR ADDITIONAL INFORMATION WRITE FOR BULLETIN HDT [illegible]35A
•
HEVI DUTY ELECTRIC CO.
MILWAUKEE WISCONSIN
HEVI DUTY
HEAT TREATING FURNACES
« ELECTRIC EXCLUSIVELY »

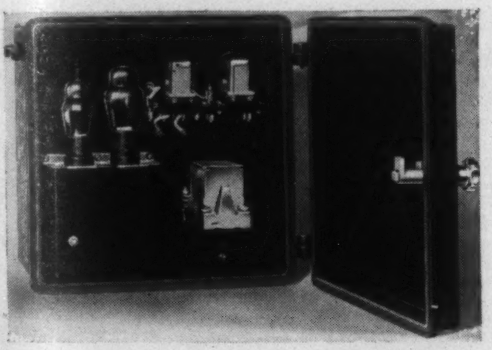
Protectoglo System of Combustion Safeguard

A new and materially improved line of "Protectoglo" equipment has just been placed on the market by The Brown Instrument Co., a division of Minneapolis-Honeywell Regulator Co., Philadelphia. This apparatus includes two separate and distinct types of relays, and a flame sensitive electrode which can also be used as a special spark plug for electric ignition. Any of the standard line of primary controllers and motor valves are used to complete the system of combustion safeguard.



The development of this equipment, which marks a very definite step forward in the combustion safeguard field, came only after several years of field experience with the old Protectoglo System, manufactured by the Minneapolis-Honeywell Regulator Co., had proved that the utilization of the electrical conductivity of the flame itself provides the greatest possible measure of safety and reliability that engineers have been able to incorporate simply and positively in any combustion safeguard.

The relays contain the thermionic tubes for rectification and amplification of the power input which, when conducted from the electrode unit to ground through the flame, operates the relay units controlling the operation sequence, main fuel valve, etc. Obviously any interruption in the circuit to ground through the flame (flame failure) causes instantaneous and positive shut-down. The cast iron dust and moisture-proof relay cases are of the universal type for either front of board or flush mounting.

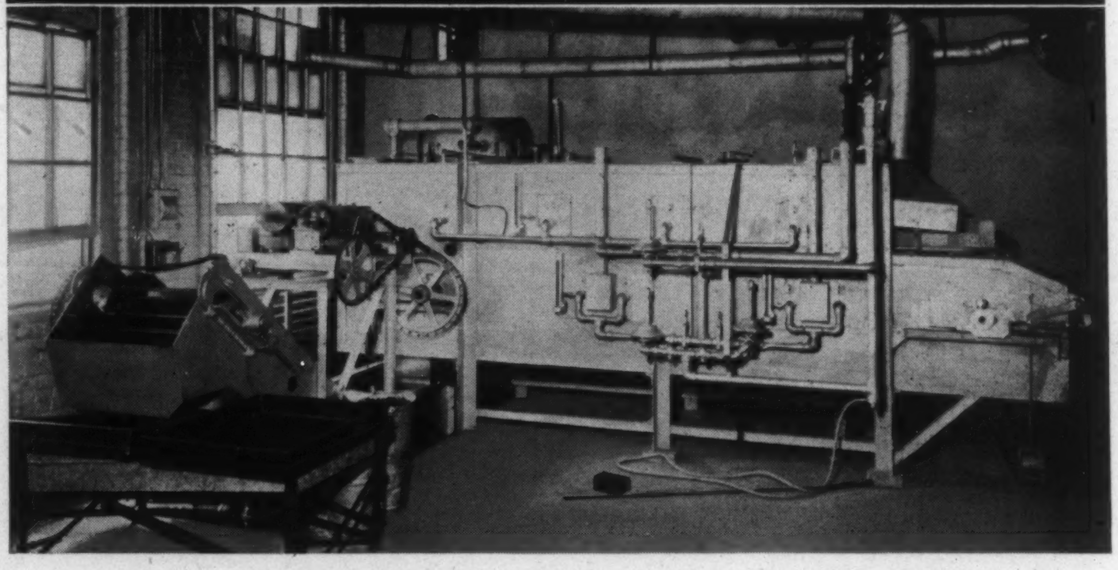


Outstanding features of the Protectoglo System: (1) Standard radio type vacuum tubes are used, assuring long tube life; (2) the vacuum tubes are located in the relay case where they are well protected and under lock and key; (3) the relay can be located in any remote location with reference to the electrode unit; (4) the relays are housed in a rugged cast iron case; (5) a rubber gasket is used on the hinged relay cover, making the case dust and moisture-proof; (6) combination door handle and built-in key lock on relay cases; (7) the terminal board is located in a separate moisture-proof chamber in the relay case; (8) electrode unit contains no moving parts and is of a very rugged design.

A system of combustion safeguard can be supplied for practically any type of burner equipment.

Heating time
REDUCED...

....when furnaces are built with Armstrong's **EF** *Brick*



USE of Armstrong's EF Insulating Fire Brick insures accurate temperature control—and more! Because it requires no fire brick protection, this lightweight semi-refractory brick can be laid up in thinner walls. The result is less time needed to bring the equipment to temperature, with a consequent saving of fuel and speeding up of production.

This brick is available for two temperature ranges—EF-22 for temperatures as high as 2200° F.; EF-26 for temperatures as high as 2600° F. Armstrong's EF Insulating Fire Brick can be used for any type of furnace—gas, oil, coal, or electric-operated.

SHOWN ABOVE—*Gas-fired, muffle-type hardening furnace for heating and hardening cap and set screws and other small parts—built by W. S. Rockwell Co. with Armstrong's EF-22 Insulating Fire Brick.*

~ ~ ~

We'll be glad to supply you with samples and data on EF Insulating Fire Brick—also the other high temperature insulation products in the complete Armstrong Line. Write Armstrong Cork Products Co., Building Materials Division, 982 Concord Street, Lancaster, Pennsylvania.

Armstrong's

HIGH TEMPERATURE INSULATION

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A Digest of the Important Metallurgical Developments of the World

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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Trend of Ore Treatment and Its Bearing on Lake Superior Iron Ore Reserves. CARL ZAPFFE. *Mining Congress Journal,* Vol. 22, Jan. 1936, pages 17-23, 52. Ore treatment was inaugurated on a large scale only 25 years ago and consisted then of one very large plant designed to treat large quantities of ore material which contained loose sandy particles that were removed by washing. By this method ⅓ of the crude ore tonnage was wasted; nevertheless it was economically practical, and it appeared to be the only applicable method of treatment likely of adoption. The equipment used in the earlier washing plants has now become simplified and the recoveries have increased greatly. The tonnage treated by washing has also been increased. Washing plants are now distributed nearly the full length of the Mesabi Range. Jigging which had been deemed impractical has now become adopted, both as a separate installation and as an adjunct where washing is used. Typical Fe ores are being converted into shipping material by roasting followed by magnetic separation. Magnetic separation of portions of Fe-bearing formations carrying magnetite has been shown feasible on a large scale. Drying wet ores and sintering fine ores is being practiced regularly in 2 or 3 districts. Flotation has also been introduced. Leaching has been found feasible in the treatment of iron ore formations of high Mn content. Mixing and grading are being carried out to a state of perfection which constitutes the ultimate purpose. BHS (1)

Gold Minerals in Brazil (Consideracoes a Mineracao do Ouro no Brasil) R. KNAUER. *Chimica e Industria,* Vol. 3, Oct. 1935, pages 92-93. Mineralogical and geological conditions, methods of ore dressing and possibilities of this Brazilian industry are briefly reviewed. Ha (1)

Variety of Improvements Noted in Concentration and Milling. CHARLES E. LOCKE. *Mining & Metallurgy,* Vol. 17, Jan. 1936, pages 13-15. Some of the improvements noted during the past year are a new model Fahrenwald crusher to be on the market soon. Symons' fine reduction cone crusher and Taylor secondary crusher continue to gain as intermediate crushers. Hadsell mill has been further improved. Latest design of ball mills of American Ball Mill Co. have boltless liners and are mounted on SKF antifriction bearings. In vibrating screens the Symons flat balanced, the Telsmith circular vibratory and Robins Conveying Belt Co's. circular throw balance screen are new. Hardinge counter current classifier is efficient. Radical change has been made in Dorr equipment. New facts have been brought out by U. S. Bureau of Mines on magnetic properties of minerals, enlarging the field of magnetic separation and leading to design of new apparatus. New aerofloat reagents of American Cyanamid Co. are Na aerofloat "B" and reagents 203, 243 and 208. No. 244 has replaced ethyl xanthate. What seems a revolutionary process for Au and Ag involves: (1) Rapid dissolution of metals in finely ground pulp by cyanide; (2) Precipitation by charcoal; and (3) Flotation of metals. VSP (1)

Recent Trends in Design and Construction of Copper Concentrators in the Southwest. C. E. RORK. *United States Bureau of Mines, Information Circular* No. 6866, Nov. 1935, 15 pages. AHE (1)

Tabular Index of Bureau of Mines Information Circulars on Mining and Milling Methods. J. R. THOENEN. *United States Bureau of Mines, Information Circular* No. 6858, Nov. 1935, 105 pages. AHE (1)

The Enzlin-Rockey Precious Metal Extraction Process. *South African Mining & Engineering Journal,* Vol. 46, pt. II, Nov. 2, 1935, page 269. Descriptive. AHE (1)

1a. Crushing, Grinding & Plant Handling

Magnetite as a Standard Material for Measuring Grinding Efficiency. R. S. DEAN. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 660, Feb. 1936, 5 pages. Gross & Zimmerley have proved that the energy actually used in grinding is proportional to the new surface produced. Gottschalk found that coercive force of magnetite powder was directly proportional to surface area. To study crushing efficiency it is only necessary to charge the machine with 10-mesh magnetic and measure the power input while grinding. The coercive force of the ground sample is then determined by a simple method. Data are given to show that the method actually works. JLG (1a)

1b. Gravity Concentration

Log Washers in the Aggregate and Flux-stone Industries. A. R. AMOS, JR. & S. B. PATTERSON. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 679, Feb. 1936, 10 pages. Describes several installations and discusses results. JLG (1b)

Some Notes on Classification Trends in America. JOHN VAN NOSTRAND DORR. *Journal Chemical, Metallurgical & Mining Society South Africa,* Vol. 36, Oct. 1935, pages 66-81. The use of the classifier as a sand circulator or ball mill loader is increasing. The flow sheets of the grinding plants of 3 mills are given and discussed. The circulating load in these mills ranges from 4 to 9 times the new feed; another is operating at 10:1 — 15:1. The only limitations to the upward trend of circulating load are mechanical. The sharpness of the separation is not unduly influenced by the amount of circulating load. An increase in the circulating sand load has resulted in increased grinding measured by increased production of material of definite fineness. The overall result is lessened costs. AHE (1b)

1c. Flotation

Flotation at Government Gold Mining Areas. *South African Mining & Engineering Journal,* Vol. 46, pt. II, Nov. 16, 1935, page 339. Fagergren flotation machines following corduroy tables are to be used to separate the pyrite for separate grinding and cyanidation. AHE (1c)

The Flotation of Gold Ore at the Bibiani Mine. W. J. CAYZER. *South African Mining & Engineering Journal,* Vol. 46, pt. II, Nov. 2, 1935, pages 281-283. The old plant, a battery of 50 stamps followed by amalgamation and cyanidation, gave sand tailings assaying 1.5 dwts./ton and slimes containing 4.2 dwts. due to Au in pyrite. A new plant consisting of a 5 x 10 ft. ball mill, Simplex classifier, Dorr agitators and thickeners gave a 3.60 dwt. tailing from a 12.0 dwt. ore. Later ball mill discharge was fed to corduroy tables, which recovered more than ⅓ the Au. The concentrate was roasted and charged back into the ball mill circuit. Extraction was more than 81% at 40% —200 mesh. Finer grinding was uneconomic, even at 92% extraction. A new flow sheet using flotation was adopted. Use of soda ash was not beneficial. $CuSO_4$ did not activate the pyrite. Cresylic acid gave no increase in extraction. Starch to depress graphite decreased extraction. Au recovery by flotation was 93% and that by cyanidation 97%. AHE (1c)

Flotation of Ores (La flotation des minerais) L. BENETT. *Génie Civil,* Vol. 107, Sept. 14, 1935, pages 248-250; Sept. 28, 1935, pages 293-296. Comprehensive summary of the present conceptions underlying flotation phenomena. Depressing agent determines the solid which will be eliminated. As depressing agents can be used: protective colloids, salts giving colloidal hydroxides when acted upon by water, metals forming with the solid a more insoluble salt than the gatherer, ions, such as cyanides, forming a polar film, changing in pH by lime addition or otherwise, and salts destroying films on previously activated solids. JDG (1c)

Concentration of Stanniferous Ores by Rheolaveurs at Manono, Belgian Congo (La concentration des minerais stannifères par rhéolaveurs, à Manono, Congo Belge) CH. BERTHÉLOT. *Génie Civil,* Vol. 107, July 27, 1935, pages 90-91. In this installation 60 m.^{3} of ore are treated daily. The ore carries 500-1100 g./m.^{3} of cassiterite and contains about 50% of clay. Cassiterite sand recovered is quite small sized, more than 70% of it is smaller than 1 mm. Recovery reaches 90-95%. A sketch of the installation and operating practice is given. JDG (1c)

Flotation of Galena and Chalcocite of Near-Colloidal Size with Potassium Amyl Xanthate and Amyl Dixanthogen. PLATO MALOZEMOFF. *Journal of Physical Chemistry,* Vol. 39, Nov. 1935, pages 1043-1056. The action of potassium amyl xanthate and of amyl dixanthogen on galena and on chalcocite of near-colloidal size appears to be identical when the mineral is ground in air. Concentration of hydroxyl ion greatly influences the flotation of sulphides. High pH is conducive to better flotation of chalcocite of near-colloidal size with amyl dixanthogen and with potassium amyl xanthate, whereas it is destructive to flotation of galena with the same reagents. It is proposed that the hydroxyl radical influences the formation of reaction products whose formation in turn affects flotation of the sulphide mineral. Under the experimental conditions employed, oxygen in grinding has a noticeable injurious effect on the flotation of chalcocite and of galena with potassium amyl xanthate and with amyl dixanthogen, as evidenced by the results obtained when the minerals are ground in virtual absence of oxygen; they are superior to any hitherto obtained in this research. The action of potassium amyl xanthate and of amyl dixanthogen on galena and on chalcocite appears to be identical when the mineral is ground in a "neutral" atmosphere, i.e. in virtual absence of air. EF (1c)

1d. Magnetic Separation

Separation of Hematite by Hysteretic Repulsion. E. W. SCHILLING & HARWICK JOHNSON. *Metals Technology, American Institute Mining & Metallurgical Engineers Technical Publication* No. 654, Dec. 1935, 13 pages. Although hematite is normally considered nonmagnetic and does not respond to the usual methods of magnetic separation it has been found that specular hematite is very active in an alternating magnetic field. If this is a polyphase field the material can be made to move longitudinally as well as laterally. Red hematite may be made magnetically active by a proper heat treatment. Such activated particles were often repelled with such force that they jumped 2" or 3" in the air. Curves show the amount of hematite moved in unit time as a function of field strength, air gap, frequency of excitation, magnitude of vibration, frequency of vibration, and heat treatment. JLG (1d)

Magnetic Separators (Nagot om magnetiska malmseparatorer) GUST G. BRING. *Jernkontorets Annaler,* Vol. 119, Oct. 1935, pages 412-452. The general conclusions of the tests are: (a) Cubes of pure magnetite ore are attracted with a force proportional to their volumes and weights; (b) the conventional formulas for calculating the attraction give values higher than are observed in practice; (c) centrifugal force plays no significant role; (d) the attractive force is approximately proportional to the field strength; (e) the attractive force falls off as the magnetite concentration is decreased; (f) the attractive force falls off very rapidly with distance; (g) iron drums are more effective than drums of non-magnetic material, but the drums must not be too thick; (h) non-magnetic ores which were heated with small amounts of reducing material produced magnetic oxides which possessed greater magnetic strength than corresponded to its content of magnetite. HCD (1d)

The Magnetic Separation of Minerals. *Mechanical World & Engineering Record,* Vol. 98, Nov. 22, 1935, pages 506-509, 512. Two magnetic separators with (a) a shaking conveyor belt and (b) with a fixed conveyor belt are described. WH (1d)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

2a. Non-Ferrous

The Zinc Industry. STANLEY A. EASTON. *Mining Congress Journal,* Vol. 22, Feb. 1936, pages 14-15. A review of the experimental work that led up to the building of the electrolytic Zn plant of Bunker Hill & Sullivan at Wallace, Idaho. This plant uses high acid electrolyte and high current density, producing a Zn of very high purity. BHS (2a)

Production of Copper Aluminum Alloys by Electrolysis of Aluminum Dross. A. I. ZHELEZNOV & B. N. MAKSIMENKO. *Legkie Metallui,* Vol. 4, June 1935, pages 18-26. In Russian. Al dross from foundries and Al_2O_3 were electrolyzed. The alloy obtained contained 0.91-1.5% Cu, 2.26-3.64% Si, and 0.58-2.04% Fe. HWR (2a)

Electrolytic Production of Magnesium Aluminum Alloys from a Cryolite Solution. A. M. ROMANOVSKII & YA. K. BERENT. *Legkie Metallui,* Vol. 4, June 1935, pages 27-40. In Russian. MgO is soluble in molten cryolite but its electrolysis is impractical because mainly Al is deposited, decomposing the electrolyte. HWR (2a)

Progress in Beryllium Concentration and Production of Metallic Beryllium (Fortschritte auf dem Gebiete des Beryll-Aufschlusses und der Herstellung von metallischem Beryllium) R. STRAUSS. *Angewandte Chemie,* Vol. 48, Nov. 30, 1935, pages 745-750. Increasing importance of Be is due to the great hardness, heat conductivity and strength which even a few % confer on the heavy metals, especially Fe, Cu and Ni; Be alone is a strong deoxidizer. The different types of Be ores from which the metal is produced, concentration processes and the production of metallic Be are discussed. A new process according to German patent 563,652 is described by which it is possible to produce Be by distillation; Be oxide is reduced in vacuum in presence of metals of the Cr group (Cr, W, Mo), and the metal condensed on a cold surface. The Be oxide is mixed with coal (or C) and Cr, W, Mo added either in the form of metal or oxide; these added metals act as catalyzers and accelerate the reduction. Ha (2a)

Beryllium (Le glucinium) ROBERT GADEAU. *Revue de Métallurgie,* Vol. 32, Dec. 1935, pages 627-637. Beryl is decomposed by grinding, sintering with Na_2SiF_6, regrinding and leaching with hot water. $NaBeF_3$ solution so produced is saturated with CaO producing BeOCaO, which is treated with HF to form BeF_2 solution. Compagnie Alais, Froges at Camargue, French 742,619, uses the reaction $6NaBeF_3 + 2H_2SiF_6 + SiO_2 = 6BeF_2 + 3Na_2SiF_6 + 2H_2O$ permitting the recovery of all F through reuse of Na_2SiF_6. BeF_2 solution is evaporated and heated to 300° C. to obtain oxyfluoride. When fluoride is desired NH_4F is added to the solution before the evaporation and the temperature is raised to 400° C. Oxyfluoride is electrolysed in Siemens & Halske process at 1400° C. after being diluted with BaF_2 (equal amounts are used). This ratio must be maintained to obtain 80% current efficiency. Higher or lower ratios reduce it pronouncedly. Molten bath is fed with the above mixture to take care of volatilization losses. Na salts must be rigidly excluded because they greatly reduce the efficiency of the operation (Fischer, *Wissenschaftliche Veröffentlichungen aus dem Siemens Konzern,* Vol. 8, 1929). BeO cannot be added as it is not soluble in fluorides. Alloys of Be can be prepared by adding either fluorides of light metals such as Al to the bath or charging chips of heavy metals which fall to the bottom and are converted into fluorides by anodic F. This permits making 40% Cu-Be alloys, alloys with a greater Cu content are heavier than the bath and are liable to fall to the bottom. A list of physical and chemical properties of Be is given. Al-Be, Mg-Be, Ni-Be, Fe-Be, Cu-Be alloy systems are described. JDG (2a)

Chlorine Method for the Treatment of Roasted Copper-Pyrite. D. M. CHIJIKOW & SH. SH. MARGOLINA. *Zhurnal Khimicheskoy Promishlennosti,* No. 8, Aug. 1935, pages 811-818. The chlorination of roasted Cu-pyrite containing 1.43% Cu and 1-1.5 g. Au/t. is described, including the mineralogical and chemical composition of the roasted Cu-pyrite, the condition of chlorination, the leaching, cleaning the solutions from the admixture and extraction of non-ferrous and noble metals. For optimum chlorination the temperature was 100° C. and time of treatment 2 hours; leaching was at room temperature for ½ hr. NA (2a)

The Reduction by Hydrogen of Stannic Oxide Contained in H.-C. Copper. W. E. ALKINS & A. P. C. HALLOWES. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 125-132. Includes discussion. See *Metals & Alloys,* Vol. 6, June, 1935, page MA 221L/6. (2a)

Electrochemistry of Sodium (Die Elektrochemie des Natriums). R. STRAUSS. *Die Metallbörse,* Vol. 25, July 1935, pages 929-930; July 31, 1935, pages 961-962; Aug. 7, 1935, pages 993-994; Aug. 14, 1935, pages 1025-1026. Deals in full detail with the production of Na from caustic soda and with the electrolysis of rock salt. The patent situation is frequently referred to. EF (2a)

Chemical Reactions Between Colloids. I. Copper and Sulphur (Über chemische Reaktionen zwischen Kolloiden. I. Kupfer und Schwefel). E. SAUER & DORA STEINER. *Kolloid Zeitschrift,* Vol. 72, July 1935, pages 35-40. Cu and S sols were prepared in different manners and mixed. A primary reaction leads to Cu(I)sulphide which changes to Cu(II)sulphide gradually or instantaneously at room temperature and on heating respectively. A colloidal suspension of Cu thoroughly freed from the electrolyte was also prepared. EF (2a)

Chemical Reactions Between Colloids. II. Mercury and Sulphur (Über chemische Reaktionen zwischen Kolloiden. II. Quecksilber und Schwefel) E. SAUER & DORA STEINER. *Kolloid Zeitschrift,* Vol. 73, Oct. 1935, pages 45-47. Colloidal Hg-sulphide is formed on mixing Hg and S colloidal suspensions. The reaction is much slower than in the case of Cu and S. EF (2a)

2b. Ferrous

Nature, Formation and Removal of Dust Through the Top of a Blast Furnace as a Function of Constitution of Oolitic Ores (La nature, la formation et l'entrainement des poussières de gueulard, étudiées en fonction de la constitution des minerais oolithiques) J. P. AREND, A. JUNGBLUT & C. ASCHMAN. *Revue de Métallurgie,* Vol. 32, Oct. 1935, pages 363-392. Dust in blast furnace top gases is seldom larger than 1 mm. diameter, most of it being under 0.25 mm. diameter. Up to 85% of the latter is composed of oolites. In minette ores the Fe content of the dust varies inversely with the size of the particles. The Fe content governs the physical properties. Magnetic seperation recovers 49% of the Fe in the dust; after roasting at 700° C. the recovery is 96% Fe. About 1/3 of the dust is charged with the ore, the rest is formed in the furnace. About ¼ of the combined water is eliminated between 100° and 260° C., ½ between 260° and 310° C. and the rest requires heating up to 500° C. Heating in reducing atmosphere dehydration is combined with reduction which is more intense for particles less than 0.25 mm. diameter, being proportional to the temperature. Dust in top gases can be separated into 3 groups according to its magnetic properties which are related to the depth to which the ore had time to settle in the furnace. About 30% of dust is strongly magnetic, containing about 55% Fe, 7% is slightly magnetic and carries 32% Fe, and the rest is non magnetic and has the composition of the original ore. A detailed mathematical analysis of the factors connected with dust removal from the furnace is given. Checking the results in an apparatus imitating conditions met in a blast furnace showed that the weight of dust removed is directly proportional to the kinetic energy of the blast. When the gases are expanded, the weight of dust carried varies inversely with the square of the cross section, the relation being a parabolic function. Friction between gases and walls is greater than theoretically expected because the dust exerts an adhesive power towards the walls which is practically independent of the speed of the gas. The amount of dust removed is directly proportional to the top temperature of the furnace. Knowing kinetic energy of the gases permits the determination of the amount of dust of any dimensions which will be carried away and of the speed at the top which will reduce the quantity of the dust removed to any desired value. The first stages of blowing remove the dust originally present in the ore and that produced by abrasion of hard minette ore. A soft and powdery ore is not necessarily the one which will form the most dust. Kinetic energy of gases in the upper levels of a blast furnace varies with the free section of the charge, volume of water carried and with the drop of temperature due to progressive cooling. To decrease the amount of dust carried away one has to reduce the energy of gases within the charge at critical levels of the blast furnace. It can be achieved by lateral deviation of the gaseous stream by vapor liberated by dehydration of the ore at proper levels. These phenomena occur under the 500° C. level, the critical zone of elimination. JDG (2b)

Material Distribution on Top of Blast Furnaces. N. L. GOLDSTEIN. *Domez,* No. 8, 1935, pages 1-10. In Russian. Stock line of a blast furnace can have either 1 or 2 slopes. In the first case the ridge of material is located at the walls, in the second, at a certain distance from them. With a single slope the fines are located at the periphery, with the double ridge the fines form an intermediate ring between large pieces concentrated at the walls and in the center. Position of the ridge has a pronounced influence on the resistance of the charge. With the same opening of the cone and the same height of the stock level the distribution of charge particles depends on their size. Mathematical analysis gives the means for calculating the distribution of different size fractions in the furnace. (2b)

Treatment of Iron Ore Fines. C. SAINT-JACQUES & L. POUPET. *Iron & Coal Trades Review,* Vol. 131, Dec. 13, 1935, pages 982-983. Saint-Jacques process was developed for treating Fe ore fines and blast furnace dust and consists in subjecting the fine material to an extremely high temperature, each separate grain being in suspension and in motion, eddying in a mass of flame, so that heat is transmitted to every particle under most favorable conditions. The dust is injected tangentially into the upper part of a furnace of the shaft type; air inlets at different levels provide the necessary motion of the gas. Tests over 12 months are described. Ha (2b)

Qualities of Pig Iron. *Metals Technology,* Jan. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 669, 16 pages. A round table discussion held in Chicago in October 1935, dealing with the quality of pig Fe as separate and distinct from chemical composition. One member claimed that pig Fe was sometimes received in the foundry that after melting did not make satisfactory castings even though it had a composition similar to Fe that made satisfactory castings. A considerable part of the discussion was devoted to blast-furnace practice. JLG (2b)

New Results in the Compressed Air Roasting of Westphalian Siderite (Neuere Ergebnisse bei der Druckluftröstung des Siegerländer Spateisensteins) H. GLEICHMANN. *Stahl und Eisen,* Vol. 55, Oct. 31, 1935, pages 1164-1165. Increasing the air pressure materially improved the output of the furnace. SE (2b)

Sintering of Fluedust and Fine Ore in a Shaft Furnace (Sintern von Gichtstaub und Feinerz im Schachtofen) J. W. GILLES. *Stahl und Eisen,* Vol. 55, Nov. 7, 1935, pages 1188-1190. Sintering of flue dust and fine ore in a shaft furnace is possible; large outputs can be attained although smaller furnaces are preferable. SE (2b)

Cleaning of Blast Furnace Gas in Whirlers (Vorreinigung von Gichtgasen in Wirblern) W. BARTH. *Stahl und Eisen,* Vol. 55, Oct. 24, 1935, pages 1129-1134. Through the use of whirlers instead of the usual dust bags much better cleaning of blast furnace gas can be obtained. Calculations are given for determining the cleaning effect of both. SE (2b)

3. MELTING, REFINING AND CASTING

The Expansion and Contraction of Molding Sand at Elevated Temperatures. H. W. Dietert & F. Valtier. *Transactions American Foundrymen's Association,* Vol. 6, Dec. 1935, pages 107-122. Good foundry practice dictates a study of the behavior of the molding material under thermal changes. The contraction and expansion of molding sands have been investigated and it is shown that fineness, clay content, moisture, sea coal and mold hardness exert important effects on these 2 properties. Molding sands with improper expansion and contraction properties often are responsible for such defects as rat-tails and scabs. The dilatometer apparatus used for the testing is described. It is concluded that the expansion of molding sand may be reduced by increasing grain size, reducing the fines, addition of combustible materials, reducing the mold hardness, increasing permeability, or reducing moisture. The opposing stresses between expansion and contraction may be reduced by increasing grain size, reducing fines, reducing mold hardness, increasing permeability, reducing moisture, or reducing the clay content. CEJ (3)

Further Notes on Oil-Engine Foundry Practice. Herbert E. Beardshaw. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 635-652. See *Metals & Alloys,* Vol. 4, Mar. 1933, page MA 84. CEJ (3)

Some Observations on the Character of Cast Iron. A. C. Vivian. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 455-466. See *Metals & Alloys,* Vol. 5, Feb. 1934, page MA 38. CEJ (3)

Cost Saving Possibilities in Foundry Ladle Heating. F. M. Reiter. *Industrial Gas,* Vol. 14, Feb. 1936, pages 20-21, 23-24. Advantages and arrangements of preheating the ladle entirely or the spout only are discussed and described. Ha (3)

Some Foundry Problems. C. A. Howe. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 615-634. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 332. CEJ (3)

Plaster Patterns in General Foundry Practice. R. Ballantine. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 543-559. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 25. CEJ (3)

New Demands on the Brass Foundry. J. Arnott. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 653-661. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 2. CEJ (3)

Routine Methods of Testing Green Sands. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 61-90. See *Metals & Alloys,* Vol. 5, July 1934, page MA 312R/7. CEJ (3)

Air Conditioning the Ford River Rouge Foundry. *Mill & Factory,* Vol. 18, Jan. 1936, pages 134-140, 586. Describes air conditioning of molding rooms in foundry and gage rooms in machine shop, and includes floor plan and cross section of room with layout of furnaces, turntables, conveyors, etc. FPP (3)

German Progress in Piston Rings, Brake Drums and Other Automobile Castings. W. A. Geisler. *Engineering,* Vol. 140, Aug. 30, 1935, pages 234-236. From a paper read before the Institute of British Foundrymen, July 1935. See *Metals & Alloys,* Vol. 7, Feb. 1935, page MA 52L/1. LFM (3)

Strickle or Sweep Molding (Le Moulage au Trousseau des Grosses Pièces) H. Fabre & H. Dubois. *Bulletin de l'Association Technique de Fonderie,* Vol. 9, Oct. 1935, pages 329-338. French exchange paper presented at meeting of the Institute of British Foundrymen, Sheffield, July 1935. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 482R/4. WHS (3)

Classifying Castings for Dispatch to Machine Shop. Francis A. Westbrook. *Iron Age,* Vol. 137, Jan. 23, 1936, pages 12-14. Describes method used by the Brown & Sharpe Co., Providence, R. I. After cleaning castings are sorted at a transfer point. Records are kept on cards which show various operations and location of castings. When order is completed a transfer slip shows final destination. Another helpful detail is a ticket file, kept at transfer point, where castings are sorted and stored before being sent out. VSP (3)

■ 3a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Production of Powdered Alloys of Low Melting Point. R. W. Rees. *Metal Industry,* London, Vol. 47, Sept. 13, 1935, page 272. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 436R/8. HBG (3a)

Cupola Furnaces in Brass Foundries (Zur Verwendung von Kupolöfen in Messinggiessereien) E. R. Thews. *Giesserei,* Vol. 23, Mar. 13, 1936, pages 135-136. American view that the cupola furnace is suitable for melting brass is not shared by the author who brings forward several reasons for lack of adaptability of this furnace to the special requirements of brass melting, among others the contact of the brass with noxious gases, coke and ash particles, necessity for an expensive fuel, high Zn losses, impossibility of obtaining the best pouring temperatures, and the necessity for installing a plant for the recovery of the Zn oxide. Also the first cost of a cupola furnace is high. Ha (3a)

The Effect of Gases on Formation of Pores When Casting Copper Alloys (Der Einfluss von Gasen auf die Porenbildung beim Giessen von Kupferlegierungen) E. Raub, F. Distel & M. Marchand. *Giesserei,* Vol. 23, Feb. 28, 1936, pages 111-114. While molten Cu, in general, absorbs gases (H, SO_2, CO_2, CO), which are liberated again on cooling, the Cu alloys behave differently. Addition of Zn makes castings dense, 1% Zn was sufficient for the almost entire exclusion of H, steam and CO_2. Castings can hardly be porous as no freeing of gases takes place which had been absorbed in molten state. Cu-Al alloys become denser with increasing Al content, and solubility of H decreases. Cu-Al melts react strongly with water vapor and CO_2, they also slag appreciably with low Al contents. The specific gravity of Cu-Sn alloys increases greatly with the Sn content; it is lowest for the alloys treated with H. Melts with more than 1% Sn treated with CO_2 and SO_2 are practically free from pores; water vapor produced pores even at higher Sn contents. Sn-Ni alloys show at first a strong increase of porosity with Ni content when treated with water vapor. CO_2 reduced the specific gravity of alloys with more than 5% Ni, due to absorption of considerable amounts of gas in the melt which is liberated again on solidification. 15 references. Ha (3a)

Cause and Effect in Bronze Founding. F. W. Rowe. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 380-391. See *Metals & Alloys,* Vol. 5, Jan. 1934, page MA 25. CEJ (3a)

Progress in the Production of Cast Bronzes. Francis W. Rowe. *Metallurgia,* Vol. 13, Feb. 1936, pages 119-120. Discussion of melting of bronzes. JLG (3a)

The Vacuum Distillation of Metals. Part II. Refining Tin and Lead by Evaporation in a High Vacuum. W. Kroll. *Metal Industry,* London, Vol. 47, Aug. 16, 1935, pages 155-156. In his experiments with Sn the author melted the metal in a sintered alumina crucible and the vapor was precipitated on a hood of the same material. Temperature could only be estimated as the Ribaud high frequency furnace precluded the use of a thermocouple. Both the distillate and the residue were analyzed. While only Katanga Sn was used in these experiments, from the data obtained, it appears that the most objectionable impurities in Bolivian Sn might be removed by distillation. In the experiments with Pb both the crucible and the condensation hood were of Fe. The melts were made in the Lorenz high frequency furnace which made it possible to use thermocouples for temperature measurement. Special precautions were taken to prevent contamination of the residue by material that had been volatilized. The method appears to be satisfactory for the elimination of Pb and As from Sn and of Zn from Pb. Other impurities are partially eliminated. HBG (3a)

A Million and a Half Brass Die-castings Yearly. Chas O. Herb. *Machinery,* N. Y., Vol. 42, Feb. 1936, pages 361-366. Principal advantages of brass die-castings over sand castings are better appearance, greater strength, more uniform cross-sections due to less likelihood of blow-holes, and more economical production in large quantities. The Polak machine is described in which the compression chamber is arranged in the die. Hydraulic pressure up to 5500 lbs./in.² is applied. Examples are illustrated. Ha (3a)

NICE WORK WE TURNED OUT ON THOSE RADIATORS, EH? THE METAL IN NO PLACE THICKER THAN THREE-SIXTEENTH OF AN INCH AND THE EDGES OF THE VANES LESS THAN AN EIGHTH OF AN INCH
YEAH, BUT IT WOULD HAVE BEEN NEXT TO IMPOSSIBLE TO HAVE RUN THE CASTING WITHOUT THAT MALUMINUM FLUX

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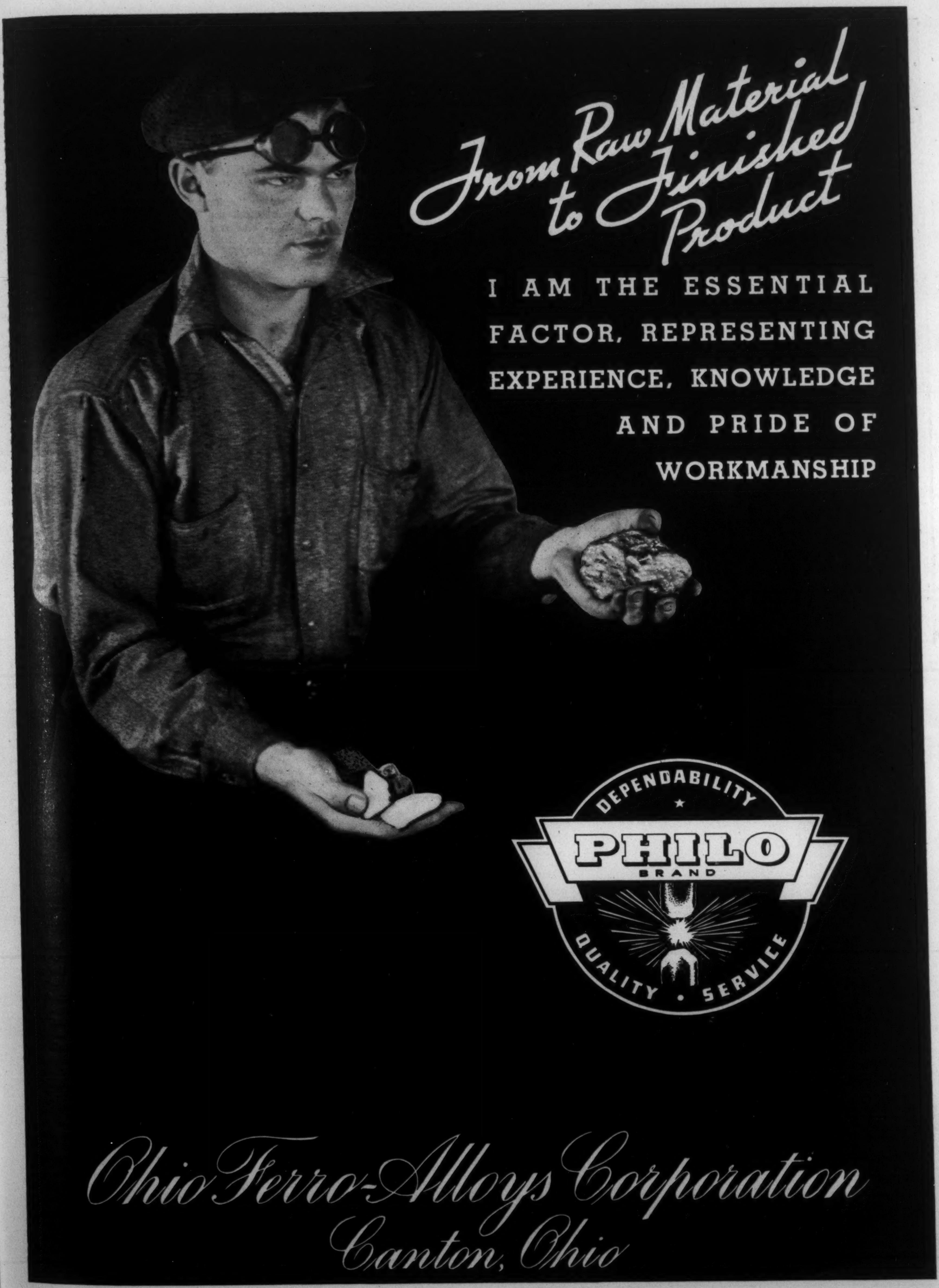
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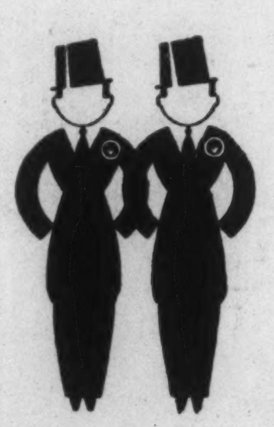

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Some Factors Affecting the Soundness of Bronze Castings. E. J. L. Howard. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 430-454. See *Metals & Alloys,* Vol. 5, Aug. 1934, page MA 384. CEJ (3a)

Effect of Melting Conditions on the Running Quality of Aluminum Cast in Sand Molds (Einfluss der Schmelzbedingungen auf die Dünnflüssigkeit (Giessbarkeit) von Aluminium-Sandguss) A. I. Krynitsky & C. M. Saeger, Jr. *Zeitschrift für Metallkunde,* Vol. 27, Nov. 1935, page 266. See *Metals & Alloys,* Vol. 6, May 1935, page MA 179R/7. FNR (3a)

Recommended Practice for Sand Cast Aluminum Alloys. Report of Non-Ferrous Division Committee on Recommended Practices. *Transactions American Foundrymen's Association,* Vol. 6, Dec. 1935, pages 1-26. In preparing these recommendations the Non-Ferrous Division of the A.F.A., through its Recommended Practice Committee, has attempted to collect through reliable sources, such information as will be of practical use to the foundrymen handling nonferrous alloys. These present recommendations are the first of a contemplated series on various groups of nonferrous alloys. Although the various practices which are treated are recommended by those considered specialists in the various fields, these practices are not intended as specifications. This first report is limited to Al alloys. General recommendations as to molding, melting and pouring, finishing, heat treatment, and defects are given. Recommended practices consisting of a discussion of chemical control limits, physical properties of castings, conforming specifications, development and fields of use are given for the following alloys: Al-Cu, heat treated Al-Cu, Al-Si, heat treated Al-Cu, and Al-Mg. CEJ (3a)

Recovering Tin from Soldered Sections. C. C. Downie. *Machinery,* London, Vol. 47, Feb. 6, 1936, page 555. General discussion of removal of Sn from tinned scrap Fe, Cu and brass by immersion in molten Pb. The solvent action of Pb on the Sn is enhanced by adding As to the bath which then deposits on the surface of the Fe or Cu scrap and tends to drive off the Sn into the Pb. Other alternative is to melt down the composite Fe Cu scrap on top of a bath of arsenical Pb. Concentration of Sn from bath is briefly reviewed as partial oxidation to obtain Sn-rich dross which is then converted to solder by reduction. WB (3a)

Magnesium and Its Ultra-light Alloys (Le Magnésium et les Alliages Ultra-Légers) Paul Bastien. *La Technique Moderne,* Vol. 28, Jan. 15, 1936, pages 39-41. Melting, refining and casting are discussed. FR (3a)

Equilibrium in Lead Smelting. S. Frederick Ravitz & Kenneth E. Fisher. *American Institute Mining & Metallurgical Engineers, Technical Publication,* No. 681, Feb. 1936, 7 pages. In the Pb blast furnaces 4 liquids are present; Pb bullion, speiss, matte, and slag. In order to determine whether or not these 4 phases are in equilibrium, crucible melts were made and the layers analyzed for Au and Ag. The materials used were dross-furnace products and Au and Ag salts were added. When different amounts of the precious metals were added it was found that their ratios in the different layers was constant, thus indicating that equilibrium had been reached. JLG (3a)

The Production and Control of Bronze Castings. Francis Rowe. *Aluminium & the Non-Ferrous Review,* Vol. 1, Nov. 1935, pages 74-75. Read before the Midland Metallurgical Societies. A general lack of density, resulting in poor physical properties, is the most prevalent trouble in bronze castings. Melting methods must be considered carefully; the Ajax Wyatt furnace appears the most promising for the highest quality castings. Centrifugal castings have a higher density and are stronger than sand castings. JCC (3a)

Application of Metallographic Theory to the Refining of Metals. Hideo Nishimura. *Suiyokwai-Shi,* Vol. 8, Dec. 1935, pages 851-858. Author discusses process of refining of pure metals such as Parks or Patinson process by applying the theory of heterogeneous equilibrium. Probable ternary diagrams to be applied in the removal of impurities from pure metals are explained and some suggestions concerning the metallurgical refining process are given. HN (3a)

Manufacture of Copper Tubing. Otto Z. Klopsch. *Iron Age,* Vol. 136, Dec. 19, 1935, pages 24-27, 86. From a paper read before non-ferrous section of the Detroit chapter of the American Society for Metals. Describes the manufacture of 99% Cu tubing by the Wolverine Tube Co. Metal is melted in tilting furnace under carefully controlled conditions. Molten Cu is kept under charcoal blanket to prevent absorption of excessive amounts of O_2. When pouring temperature is reached P-Cu is added to deoxidize charge. Charge is poured directly into billet mold. After cooling billet is headed by ladle addition of molten Cu. Billets are heated to extrusion temperature in oil fired muffle furnace. Heated billets are upset by a special device to insure snug fit. After 2 or 3 passes through die tube is annealed to refine grain structure. Bright annealing of tubes is done in General Electric furnace. Tubes used for refrigerant, gasoline or oil must be free from scale and moisture. VSP (3a)

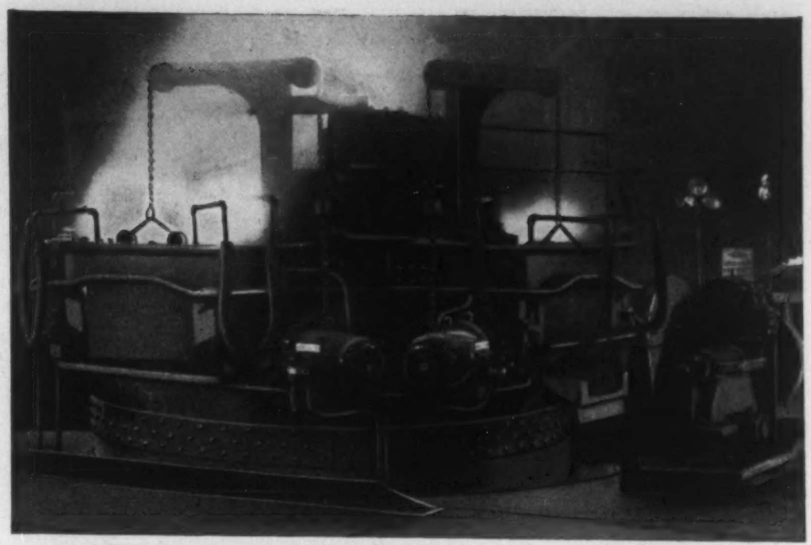
Electrolytic Solder. R. P. E. Hermsdorf & Max Heberlein. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 680, Feb. 1936, 9 pages. Pb-Sn alloys obtained from scrap are refined electrolytically and made into high-grade solder. The impure alloys are first fire refined to reduce Cu content and contents of some other impurities. The semi-refined alloy is cast into anode plates and electrolyzed in a Sn-Pb fluosilicate solution. The usual anode analysis is 62% Pb, 35% Sn, 2% Sb, 0.25% As, 0.05% Cu, 0.05 oz./ton Au, and 30 oz./ton Ag. A residual anode slime that adheres to the anode but does not make it passive is produced. Insufficient H_2SiF_6 causes hydrolization of $SnSiF_6$. The electrolyte is circulated over shot of 30 Sn-70 Pb to cement out impurities. No attempt is made to produce cathodes of definite Sn and Pb contents. The cathodes produced are analyzed and melted with either virgin Sn or Pb to make solder of the desired analysis. The Sb content of the electrolytic solder averages 0.02%. JLG (3a)

3b. Ferrous

C. H. HERTY, SECTION EDITOR

Working Conditions Inside of an Open Hearth Furnace. I. D. SEMIKIN. *Domez*, No. 8, 1935, pages 10-25. Life of furnace walls and roof depends on the equilibrium between heat supplied and radiated from them, being independent of the temperature of the flame. Thermal load on the roof is not uniform. Along the length of each roof is present an area which has a higher temperature than the rest of the wall and where failures start under normal operations. Width of flame is usually about ⅓ the width of the bath. A narrower, hotter flame can produce the same results. Small decrease in temperature of the flame requires increasing its width several times to get the same heat supply. Greater efficiency is usually obtained when the flame is farther from the roof. Mathematical study of heating phenomena in the melting zone shows the possibility of overheating the bath above the roof by about 20° C. max., impossibility of overheating the bath above the temperature of an insulated roof and the advantage of thin roofs and walls for introducing in the furnace more heat per unit of time when the flame has the required heat capacity. Increasing flame temperature does not produce a higher temperature in the bath, but increases sharply the heat transfer to it without harming the furnace. When surface temperature of bath is under the temperature of roof, heat transfer per unit of bath surface is not affected by the amount of insulation of the furnace. High flame temperature cuts down by about 25% the amount of fuel per ton of metal, and shortens the time of heat about 10% by reducing time for melting down. Chemical reactions between the molecules of hot gases take place instantaneously. Speed of combustion depends only on the rate of mechanical mixture of air with gases. Flame of an open hearth furnace cannot be the result of burning a mixture already formed. It is composed of two separate streams of gas and air. Turbulency of streams is the major factor affecting speed of combustion. Outside eddies produce larger surfaces along which contact of air with gas occurs. Air and gas travelling in parallel high velocity streams create the best combustion conditions. Each section of the flame along the whole length of the furnace receives here a fresh supply of air from its primary source, the parallel stream of air. Good efficiency of such ports as Moll or McCune does not depend on a preliminary mixture, but on the instantaneous formation of an insulating layer of combustion gases between air and gas streams and on the high velocity with which the parallel streams enter the furnace. Present speeds, particularly in larger furnaces, are entirely inadequate. Life of their roofs is about half as long as in smaller ones. Large angle with the horizon used for the present air ports only interferes with oxygen supply in the second half of the furnace while the first gets its oxygen anyway. 3 types of the wear of roofs are often observed. They can be worn in triangular section along the back wall, in a long band parallel to the axis of the furnace and particularly pronounced in the second half of it, or uniformly all over the roof. In the first case, a powerful stream of air moves downwards at an angle of 30°-45° on the stream of gas. It has a pronounced inertia and creates an aspirating effect between itself and the roof. Gaseous stream moves slowly and does not have a sufficient inertia to overcome damming effect produced by the air. It is broken, and portions of it are squeezed out at the sides rising along the periphery of the furnace to the areas of partial vacuum. Though the phenomenon is not strictly localized, it recurs frequently enough in the same spots to groove the roof in the manner described. Cutting down the inertia of air by limiting its supply leads to the burning of ports. In the second case air stream moves slowly but gas has a high speed. On impinging on the bath surface air loses more of its speed and slowly moves along the furnace gradually mixing with the gas and burning. It does not have sufficient inertia to follow the flame and rises to the roof overheating it. The second half of the furnace is insufficiently supplied with oxygen unduly lengthening the flame and burning ports and uptakes. Destructive effect is more pronounced the lower the gas speed, the greater the angle of air ports and the longer the furnace. Third type of wear is associated with a proper proportioning of gas and air with the length of the furnace. Gas stream must be the major factor controlling the motion of the furnace atmosphere, if a long roof life is desired. Air stream must assist it. Angle of inclination of air ports always has a negative effect on the control of the motion of gases in the furnace. Doubling length of a furnace calls for a practical doubling of gas and air speeds. Small furnaces last longer because their speed of gas, 4-9 m./sec. and of air, 1.5-3.5 m./sec. (German practice) are kept the same for larger furnaces, instead of being 8-10m./sec. for gas and at least 0.7 of this value for air. Dimensions of the ports should not be designed on the basis of average fuel consumption, but on the fuel consumption during the finishing of the heat. This is associated with a uniform speed of the gas stream. During the charging period its heat capacity can be increased by additional burners. The arrangement will lead to changing loads on gas ports, but these can be taken care of by a proper stack. In the first half of the furnace gas stream receives about ½ the air used for its combustion from the sides. This permits the protection of roof by locating the air ports in the horizontal plane according to Venturi principle and building the ports with a slight elevation to the roof instead of the usual inclination in the opposite direction. The arrangement tends to increase the efficiency of the flame. (3b)

Non-Metallic Impurities in Open-Hearth Steel. FOLKE W. SUNDBLAD. *Iron Age*, Vol. 136, Nov. 14, 1935, pages 21, 76-77. Certain chemical reactions in steel bath produce surface disturbances known as boils. There are 3 types of boils, namely lime and ore boils, and bottom boil which distinguishes itself from the others in appearance. Slag fluidity influences oxidation and therefore the speed of oxidation is materially in direct proportion to the fluidity of slag. This becomes of special significance when making a large high-C heat. Instantaneous deoxidation of large bath is likely to entrap foreign impurities to far greater extent than smaller unit with low temperatures and slow oxidation. By study of bottom boil the direct causes are primarily physical, as the attack upon the bottom is almost entirely due to temperature of metal, which is dependent upon the oxidation of its C. Next important step in evolution of open-hearth steel is to change the working methods of tonnage unit, based on entirely different speed of oxidation than that used by smaller furnace, where quality is main object and time element of minor importance. VSP (3b)



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6-36

Cast Iron Pulleys for Wire Ropes. *Foundry Trade Journal,* Vol. 53, Dec. 12, 1935, pages 433, 434. Extract from the report of the Wire Ropes Research Committee. Some users favor chilled-iron pulleys for wire ropes. It is very difficult to justify this view, because a hard surface to the pulley tread would appear to lead to greater resistance to indentation by the wires, with greater bearing stress between the wires and the pulley, and also, probably, greater bending stress. A certain amount of bedding of the wire into the metal groove must give an increased bearing area, and probably relieves the sharpness of the bend where it is most severe, at the inner side of the rope adjacent to the pulley. It is not possible to cast chilled-iron pulleys to fit the ropes, nor is it practical to grind the grooves. It was also shown that a rope had a longer life when it was used dry than when it was lubricated. Many tests were made to compare the life of ropes on chilled and on ordinary cast-iron pulleys. It has been shown that chilled-iron pulleys do not permit so long a rope life as cast-iron pulleys. The Committee has also investigated the relationship between rope and the material used for the pulley groove. Similar pulleys were cast in different metals, and in addition cast-iron pulleys were made with an under-cut groove which could be filled with appropriate materials. All pulleys were grooved to fit the rope in use and the ropes were lubricated. The test results and other data are given in 4 tables. Plastic wood seems to be very satisfactory as material for pulley grooves.
AIK (3b)

Adopts Test Block Control. Henry P. Biegel. *Foundry,* Vol. 63, Nov. 1935, pages 31, 82. Describes a useful method for testing the quality of Fe at casting time. Principle of test is based on Si content of Fe which is reflected by depth of chill or lack of it. Test block used is ¾″ x 2½″ x 5″ and is poured with narrow face against a chill and in open mold. When cooled to a dark red it is quenched slowly in oil and cooling finished in H_2O. Quality of Fe is indicated by characteristic appearance of fracture. Method is useful in any type of gray Fe foundry.
VSP (3b)

Suggested Improvements in Purchase Requirements for Important Steel Castings. Charles W. Briggs. *Journal American Society of Naval Engineers,* Vol. 47, Nov. 1935, pages 532-537. Casting design is based on accumulated practical experience rather than the application of design fundamentals. Author ascribes unsoundness in steel castings to this cause rather than to poor foundry technique either in molding or steel melting. A number of critical questions are put as to the control of solidification in the casting. The case of the U. S. Navy in awarding contracts for steel castings is taken up and criticized because cognizance is not taken of the availability to the lowest bidder of equipment necessary for producing sound castings. γ ray inspection is mentioned as important non-destructive test for checking casting unsoundness, and its use by manufacturers is suggested for improving quality. Author suggests preparation of government list under several headings such as turbine casings, high pressure steam castings, etc. for manufacturers of preferred acceptability, inclusion on the list to be conditional upon passing government inspection of pilot casting made by the company.
WB (3b)

Aluminum Additions in Modern Commercial Steels. H. W. McQuaid. *Metal Progress,* Vol. 28, Nov. 1935, pages 33-37, 78; *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 797-838; *Steel,* Vol. 97, Oct. 14, 1935, pages 45-46; *Iron Age,* Vol. 136, Oct. 10, 1935, pages 20-27; Oct. 17, 1935, pages 28-34, 84, 86, 88. Tenth Campbell Memorial Lecture delivered at A.S.M. convention, Chicago, 1935. From an addition primarily made to quiet wild heats and supposedly harmful in effect Al has become most important factor in production of uniform hardenability and grain size in steel. Tendency of Al to produce fine grain and shallow hardening is much more pronounced than effect of Mn in opposite direction. Mn and Ni tend to stabilize the austenite and make ferrite more rigid reducing the tendency to coalesce the carbide. An active carburizer which builds up carbide at surface faster than austenite can absorb it tends toward a retention of fine grain. It is found that the Al addition to produce the characteristic effect is less for low O_2 metal than high O_2 metal (electric steel than open hearth). The effect of Al is therefore suggested to be one of decreasing the solubility for carbide thus promoting coalescence of carbide and its attendant effect to impede grain growth. This effect will be felt regardless of the presence of deep hardening additions (of Mn) if Al is appropriately high above that required to deoxidize. The experimental data on 42 special heats are reported in full in the complete lecture in the *Transactions. Metal Progress* contains only an abstract and discussion of conclusions and theory.
WLC + MS + VSP (3b)

Open-Hearth Insulation Advances. *Steel,* Vol. 98, Jan. 6, 1936, pages 240, 336-337. Presents opinions of several authorities as to important developments in steel making in 1935. Includes use of Cu molds and stools; new types and methods of furnace insulation; new devices for control of furnace atmosphere and roof temperature; new types of furnace design; continued interest in grain size control and slag control; new types of soaking-pits; improved fire-clay nozzles; and magnesite stoppers for pouring special steels.
MS (3b)

Making Stainless Bimetal. Ya S. Ginzburg, M. B. Katzenelenbogen & V. S. Lurie. *Kachestvennaya Stal,* No. 8, 1935, pages 27-34. In Russian. Method for making bi-metal sheets by casting soft steel around 2 plates of stainless steel placed in ingot molds proposed by the authors is described. Properly cleaned sheets of stainless steel are coated on one side with a slurry of burned MgO and dried to form a coating 0.2-0.3 mm. thick. Coated surfaces are placed side by side and the sheets are either clamped together mechanically or welded around their periphery. 4 clamps are required for one meter sheets. Packets so produced are suspended in ingot molds to be fully immersed in the metal. Welding of sheets takes place in rolling, and is better with longer time of soaking at high temperatures. Rolling practice and roll design used for production of common sheet bar are suitable for bi-metal rolling. Normalization at 1050° C. does not produce coarsening of grain in soft steel layer as drawing and quenching do. Pickling in 47% HCl, 5% HNO_3, 48% H_2O without any inhibitor affects both layers approximately equally. The use of an inhibitor caused overpickling of soft steel. See also "Electrolytic Iron Provides Bond in Cladding with Special Alloys," R. R. Rogers, *Steel,* Vol. 98, Feb. 10, 1936, page 34.
(3b)

The Corby Iron and Steel Works of Messrs. Stewarts and Lloyds, Limited. *Engineering,* Vol. 140, Nov. 1, 1935, pages 471-473. Illustrated article describing the new Northamptonshire, England, steel plant.
LFM (3b)

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Research on Cast Iron. *Engineering,* Vol. 140, Nov. 15, 1935, pages 531-532. From the fourteenth annual report of the British Cast Iron Research Association. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 56R/6.
LFM (3b)

Open Hearth in 1935. K. C. McCutcheon. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 47-49. Summarizes progress and changes of the year. These include attention to open-hearth fuels; savings in fuel and protection of brickwork by automatic control of fuel and air; use of pyrometers to control tapping, pouring, and roof temperatures; increased use of insulation; use of many new ladles of welded construction; higher mold life; improved design of existing furnaces; better bricks for special furnaces; increased size of heats tapped; better refractories; increased use of slag control; and improved pouring equipment.
MS (3b)

An Up-to-Date Foundry Layout. A. B. Jacobus. *Iron Age,* Vol. 137, Jan. 16, 1936, pages 26-27. Describes the foundry layout of the Fairbanks Scale Works in St. Johnsburg, Vt. Greatest savings have been made in production of castings for the bases of portable scales. Brass and Al castings are made in an adjacent foundry. Continuous pouring system is used throughout the foundry. Illustrates layout of Fe foundry.
VSP (3b)

Advantage of a Melting Sheet for Starting an Electrical Steel Furnace Installation (De l'utilite d' un diagramme de marche pour la mise en route d'une installation de four électrique à acier). E. Decherf. *Journal du Four Electrique,* Vol. 44, Nov. 1935, pages 395-398. When breaking in inexperienced furnace operators a predetermined melting sheet is advantageous. An example of one is given.
JDG (3b)

Copper Stools for Ingot Molds. Clyde E. Williams & H. B. Kinnear. *Metals & Alloys,* Vol. 6, July 1935, pages 169-172; Aug. 1935, pages 213-217; correction to Fig. 16, Nov. 1935, page 331. The higher thermal conductivity with faster removal of heat from the molten steel justifies and makes economical the use of Cu stools for steel ingot molds. Cu used is "tough pitch" containing 0.04% O_2 and is cast in slabs or cakes in water cooled molds to obtain a smooth surface requiring no machining. Experience indicates Cu stools should weigh 2/3 the ingot weight, that thickness should be at least 1/55 the bottom area of the ingot, that peening of small thermal cracks as they appear postpones failure, that laminated stools made of Cu bricks set in cast iron frame or Cu inserts in Fe stools are advantageous in reducing Cu scrap. Crediting stools only with scrap value of Cu returned means stools should give a life of 500 heats. The first Cu stool in commercial use has gone 900 on one side and 600 on the other side. Many others still in use have passed 500 heats. These were massive stools and peening was not employed or other precautions taken. Cu stools are evidently economical. Other savings are effected, bulging of the bottom of the ingot is eliminated, rejections are normal and mold life is increased 30-100%. Temperature measurements in stools and molds are reported and indicate much more rapid cooling from the bottom with little difference further up the mold. This is the critical location with regard to ease of stripping. Experimental work on all Cu molds is encouraging but incomplete.
WLC (3b)

4. WORKING

Changing Practice in the Use of Oil in the Forming and Cutting of Metals (Umstellungsmassnahmen bei der Oelverwendung in der spanabhebenden und spanlosen Formgebung der Metalle) K. Krekeler. *Zeitschrift für Metallkunde,* Vol. 27, Nov. 1935, pages 262-263. Because of the increasing scarcity of the vegetable and animal oils which have in the past been used in the forming and cutting of metals, the substitution of special mineral oils is being practiced. Mineral oils which leave no residue or blemish on rolled or drawn metal after working and annealing are now available. The corrosion and staining of hot rolled metals by the use of cooling water on the rolls is being retarded by the introduction of a special mineral oil into the water. Vaseline is being used in the drawing of Al wire and emulsified mineral oils are being employed for the cutting of metals. No specifications for the oils are given. FNR (4)

Recent Advances in Pressure-Forming Processes. H. Haake. *Engineering Progress,* Vol 17, Jan. 1936, pages 1-5. Recent atomic research and the new concepts relative to structure and properties of crystals have effected great changes in the processes of forming and deforming metals and other materials which are used in pressed form in industrial operations. Hot and cold working processes for metals and artificial resin products are discussed. 29 references. Ha (4)

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Effect of Material of Roll, of Rolling Velocity, Width of Strip and of a Preceding Cold-deformation in Cold-rolling of Strip-steel (Der Einfluss des Walzenwerkstoffes, der Walzgeschwindigkeit, der Bandbreite und einer voraufgegangenen Kaltverformung beim Kaltwalzen von Bandstahl) Werner Lueg & Anton Pomp. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 17, No. 20, 1935, pages 219-230. Exhaustive tests permitted drawing the conclusions that for the same quality of the roll surface, the material of the rolls has no effect on the rolling process. The rolling velocity did not show any effect in the range of speed change from 1:130. The effect of the section of material to be rolled is such that the roll pressure increases with the width of the strip linearly for the same reduction. Above a ratio of about 15 between width and thickness of the strip, no effect of the width could be observed. The structural state of material has also some influence; for the same reduction rolling pressure and resistance against deformation increase with the degree of preceding cold-deformation at first rapidly and then slower. For reductions more than 20%, both quantities increased more sharply again, due to the flattening of the roll surface with the increasing strengthening of the material by cold-deformation. Test curves illustrate the conditions. 10 references. Ha (4a)

New Light Bar Mill in Zig-Zag Layout (Neuzeitliches Feinstahlwalzwerk in Zickzackanordnung) E. Weber. *Stahl und Eisen,* Vol. 55, Sept. 26, 1935, pages 1029-1031. A new light-bar mill with ten 2-high roll stands; the first 6 stands are continuous, the rest in zig-zag arrangement. The layout with furnaces, rolling mills, and auxiliary appliances, is described. The capacity is 20,000 tons per month. SE (4a)

Progress in the Knowledge and Practice of Plastic Forming. II. Rolling (Fortschritte in der Erkenntnis und Handhabung der Verfahren zur bildsamen Formgebung. II. Walzen) E. Seibel. *Metallwirtschaft,* Vol. 15, Jan. 31, 1936, pages 103-107. A historical treatment of the progress made toward an understanding of (a) the power and mechanical requirements of rolling, (b) the flow of material, and (c) a theory which will explain all observed phenomena and predict those which will result from any change in practice. The discrepancies between actual power consumption and that required by simple theory promoted research along all related lines. Methods of accurate measurement and analysis of rolling processes were developed and have provided a basic understanding of the relations between such factors as roll diameter, thickness of material, amount of reduction, temperature of working, friction between rolls and work, and deformation of rolls. But the exact control of all processes, especially the production of complex forms, requires still further advances of theory and practice. GD (4a)

Straightening Machine for Finest Sheets (Feinstblechrichtmaschine) L. Reichert. *Aluminium,* Vol. 18, Feb. 1936, pages 48-50. Principle and types of multiple roll machines for thin sheets are described; the straightening velocity is 5-6 m./min. Ha (4a)

Effect of Rolling Conditions on the Cold Rolling of Strip Steel (Der Einfluss der Walzbedingungen beim Kaltwalzen von Bandstahl) W. Lueg. *Stahl und Eisen,* Vol. 55, Oct. 17, 1935, pages 1105-1112. The rolling speed is without appreciable influence; with hardened Cr steel or white cast Fe rolls the type steel rolled is also of small influence; the important factors are the rolled section, friction, and degree of reduction. Care should be taken in lubricating, polishing, and getting hard surface on the rolls. SE (4a)

Experiences with the Roll Pressure Tester "Pasopos" (Erfahrungen mit dem Walzendruckprüfer "Pasopos") Werner Lueg & Anton Pomp. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 17, No. 19, 1935, pages 213-218. The new instrument measures the deflection in rolling of the lowest point of the crown of the lower roll in a roll stand. A definite ratio between this deflection and the sum of the roll bearing pressures was found. Tests made in rolling of different steels are described. Ha (4a)

Roll Design for Structural Shapes (Ueber das Kalibrieren von Formstahl) C. Holzweiler & T. Dahl. *Stahl und Eisen,* Vol. 55, Oct. 10, 1935, pages 1081-1086. Roll design for various H-beams is discussed. SE (4a)

Engineering Developments in 1935. Ralph [H.] Wright. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 65-66. Deals with installations of rolling-mills and auxiliary equipment, with chief attention to electrical equipment. MS (4a)

Hot Rolled Sheet Packs Are Delivered to Shears by System of Conveyors. *Steel,* Vol. 98, Feb. 17, 1936, pages 59-60. Brief description of conveyor system which serves a combination-type sheet mill and minimizes manual handling of sheets to squaring shears. MS (4a)

Co-ordinated Design and Operation Feature McDonald Hot Strip Mill. *Steel,* Vol. 98, Feb. 24, 1936, pages 32-37, 57. Describes 4-high 43″ continuous hot-strip mill recently completed at McDonald, Ohio, plant of the Carnegie-Illinois Steel Corp. MS (4a)

Production of Tubes in Austria (Die Röhrenerzeugung in Österreich) *Montanistische Rundschau,* Vol. 28, Feb. 16, 1936, 4 pages. A description of the Ternitz tube mill of the Schoeller-Bleckmann Stahlwerke A.-G. This plant produces tubes up to 114 mm. diameter. It has a power consumption of 12,000 kw. 2 open hearth Martin furnaces, 3 electric furnaces, and 1 high frequency crucible furnace are used. The annual capacity of the plant is 18,000 tons, 300 men being employed. Drill steel is also produced in addition to tubes. BHS (4a)

Universal Plates for Fabricated Steelwork. *Engineering,* Vol. 141, Jan. 3, 1936, page 10. Illustrated article describing the rolling mill of Messrs. Dorman, Long and Company, Limited, Middlesbrough, England. LFM (4a)

The Hot Rolling of Sheets. *Aluminium & the Non-Ferrous Review,* Vol. 1, Nov. 1935, pages 53-55. Open discussion held by Midland Metallurgical Societies. Chief problems of sheet rolling are to secure uniformity of thickness and a good surface free from scale. To secure uniformity, sheets are often rolled in "packs," shuffling the order frequently. To remove scale from Cu, one suggestion made in the discussion was to use soluble oil for quenching after hot rolling. JCC (4a)

McDonald Mill of the Carnegie-Illinois Steel Corporation. *Blast Furnace & Steel Plant,* Vol. 24, Mar. 1936, pages 224-230, 234. **Coordinated Design and Operation Feature New Rolling Mill.** *Iron Age,* Vol. 137, Feb. 20, 1936, pages 44-45, 74. Detailed description of 43″ continuous hot strip mill and auxiliary equipment at McDonald plant near Youngstown, O. VSP + MS (4a)

Modern Developments in Cold Rolling Mills. C. E. Davies. *Metallurgia,* Vol. 13, Jan. 1936, pages 79-81; Feb. 1936, pages 107-108. General review of up-to-date mills, including those used for ferrous and non-ferrous materials. JLG (4a)

Investigation of the Power Consumption in a Blooming Mill (Untersuchungen über den Arbeitsaufwand beim Blockwalzen) H. Hoff & T. Dahl. *Stahl und Eisen,* Vol. 55, Nov. 7, 1935, pages 1182-1188. Earlier results were confirmed. The composition of the work and particularly the roll design affect the power consumption. SE (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Flakes in Forged Steel (Les "flocons" dans les pièces d'acier forgées) Leon Guillet & Marcel Ballay. *Revue de Mètallurgie,* Vol. 32, Nov. 1935, pages 522-530. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 116R/7. JLG (4b)

The Upsetting of Aluminum and Aluminum Alloys (Das Stauchen von Aluminium und Aluminium-Legierungen) A. v. Zeerleder, R. Irmann & E. v. Burg. *Aluminium,* Vol. 18, Feb. 1936, pages 41-48. The specific upsetting energy was determined and is shown in spatial diagrams for Al and several Al alloys, as a function of temperature and amount of alloying element. Very great differences exist both among the Al alloys and the heavy metals and Al alloys, as the table shows:

Material	Specific upsetting pressure for 50% upsetting in kg./mm.^{2}	working temperature in °C.
Pure Al, 99.5%	1.3-0.8	500-550
Brass	2.0-0.8	700-800
Anticorodal	2.8-1.9	450-500
Cu	4.0-2.6	700-800
Avional D	4.1-3.8	420-440
Peraluman 2	4.8	420-440
Iron	5.0-4.0	1000-1100
Peraluman 3	5.0	420-440

The upsetting velocity and frictional forces have a great influence; the tests were made with an average speed of 60 sec. for a 50% upsetting. Ha (4b)

Forged-steel Die-block Department of Messrs. Thos. Firth and John Brown, Limited. *Engineer,* Vol. 161, Feb. 28, 1936, page 239; *Engineering,* Vol. 141, Feb. 28, 1936, page 229. The company's new plant at Sheffield consists of gas-fired furnaces for reheating, normalizing, hardening and tempering, an oil-quenching tank and tools for making parallel-sided and tapered die blocks. An output of 2 tons per shift is maintained. Compositions are indicated for blocks for stamping plain carbon steels, tough alloy steels, etc.; heat treatment is also considered. LFM (4b)

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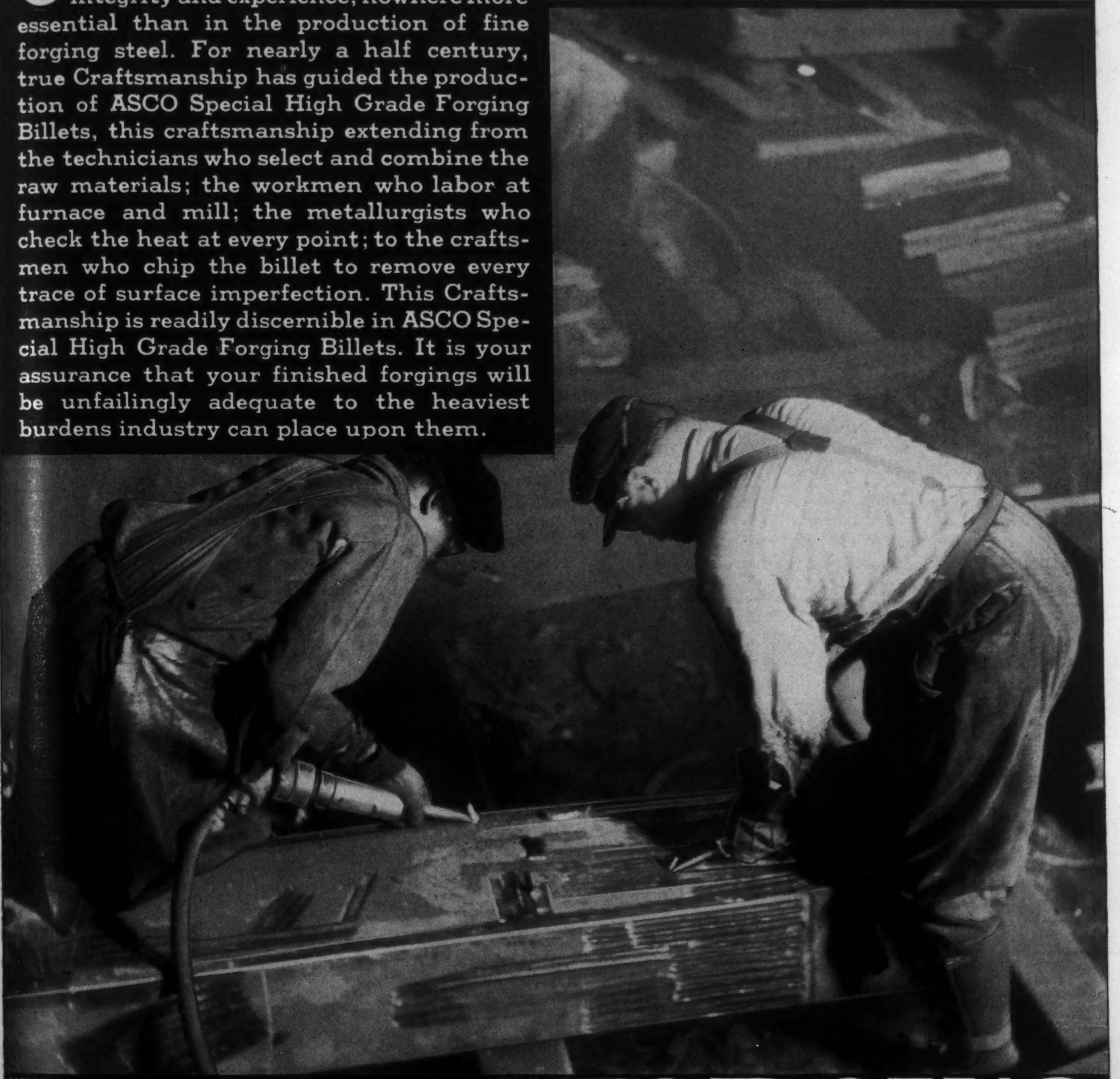

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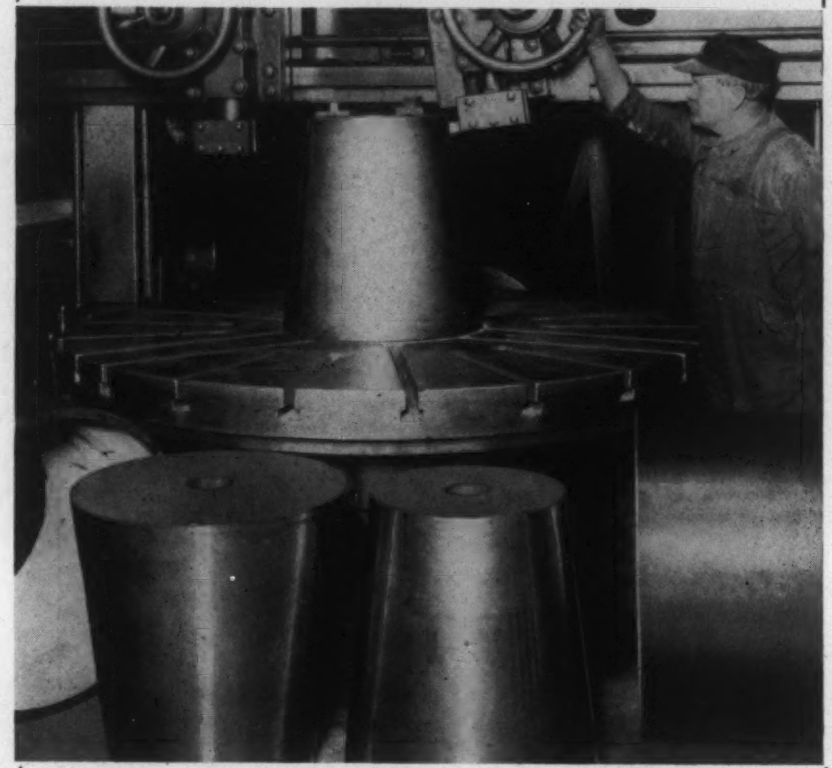

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4c. Cold Working, including Shearing, Punching, Drawing & Stamping

Rubber and Wood Used for Dies in Forming Airplane Parts. Chas. O. Herb. *Machinery,* N. Y., Vol. 42, Mar. 1936, pages 425-430. To save the cost of expensive dies when only comparatively few pieces have to be made dies of wood or Zn faced with thin sheets of cold-rolled steels, and rubber pads in combination with Zn dies have been successfully applied; the process of making Zn dies from plaster of Paris pattern and their use is illustrated by examples. Ha (4c)

Metal Stamping in Small Lots on a Production Basis. *Mill & Factory,* Vol. 18, Mar. 1936, pages 65-66. The early days and present set-up of the A. Rogers Mfg. Co. plant at Dayton are described. Profitable production is based on use of temporary dies to establish correct tolerances for parts, thus avoiding corrections after permanent tooling, and excessive die charges. FPP (4c)

Flow of Metal in Stampings. Earl C. Booth. *Product Engineering,* Vol. 7, Mar. 1936, pages 90-92. Better materials for stamping and drawing processes are now available so that stamped and deep-drawn parts are widely used as their surface is cleaner and decorative finishes can often be applied directly. The initial design of a sheet to provide for the increased area to secure proper flow and avoid cracks is discussed and illustrated by a few practical examples. Ha (4c)

4d. Machining

H. W. GRAHAM, SECTION EDITOR

Velocity of Machining and Choice of Tools (Vitesse d'Usinage et Choix des Outils) Wojcik. *Usine,* Vol. 45, Jan. 23, 1936, pages 35-37. Factors influencing speed and shape of tool dependent on type of metal to be machined and on material of the tool are discussed; tables of speed, feed and cutting angles for different materials are given. Ha (4d)

Machining Metals with a Gas Flame. Lipetzki. *Kachestvennaya Stal,* No. 9, 1935, pages 58-60. In Russian. Advantages obtained in rough machining using gas cutters are pointed out and the methods used are described. Data presented are taken from Linde Co. publications. (4d)

Tungsten Carbide and Cobalt Cutting Material. Arthur Haslam. *Metallurgia,* Vol. 13, Feb. 1936, page 103. Points out superiority of sintered W-C tools in machining several materials that tool steels cut with difficulty if at all. JLG (4d)

Tool Steel Industry Is Prepared to Meet the Challenge of New Developments in Machines. R. Edsom Emery. *Steel,* Vol. 98, Mar. 9, 1936, pages 55-56. Modern machine-tools have increased speed and power, greater accuracy, and ease of operation. Introduction of new cutting materials has made possible increase in power and speed. Varieties of tool-steels to meet various requirements have been increased considerably. Chemist and metallurgist have contributed an important part to perfection of present-day tool-steels. Continued research is needed, however. MS (4d)

Factors Influencing the Nature of the Cutting-Speed/Tool-Life Curve. O. W. Boston, W. W. Gilbert & C. E. Kraus. *Metal Treatment,* Vol. 1, Autumn 1935, pages 141-142. See "The Life of Turning Tools as Influenced by Shape," *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 516. JCC (4d)

Machining a New Free-cutting Aluminum Alloy in Automatics. *Machinery,* N. Y., Vol. 42, Mar. 1936, pages 464-465. Al alloy 11S (described in *Machinery,* Aug. 1935, page 751) is best machined with the standard 18-4-1 high speed steel, or, when the cutting speed is not very high, as for drilling of small holes, ordinary C steels can be used. General information on lubricants and tool shapes are given. Ha (4d)

Broaching Facilitates Production of Dodge Connecting Rods. *Iron Age,* Vol. 137, Feb. 20, 1936, pages 42-43. Improved quality and an increase of 360 pr. of rods and caps/hr. has been achieved by the Dodge Bros. Corp., by installation of 5 vertical broaching machines. VSP (4d)

Tungsten Carbide, An Example of the Profits and Problems of Modernization. Edwin L. Cady. *Mill & Factory,* Vol. 17, Nov. 1935, pages 37-40. Describes application of W carbide equipment to a modernization program. After preliminary exploratory period W carbide has proved advantageous for cutting-tools, wire-drawing dies, electrical contact points, lathe center points, etc. with several hundred percent improvement in tool life or operation time often reported. Failures due to "abruptness" are described and methods of avoiding them mentioned. Lists for checking possible applications, performance and capital saving are included. FPP (4d)

The Torque and Thrust of Small Drills Operating in Various Metals. O. W. Boston & W. W. Gilbert. *Transactions American Society of Mechanical Engineers,* Vol. 58, Feb. 1936, pages 79-89. The results of a detailed study are recorded in which drilling with small drills from ⅛″ to ½″ diam. was done and the influence of speed, torque exerted and angle of helix was considered for 9 ferrous and nonferrous metals. The results are shown in curves. 13 references. Ha (4d)

A Five-Point Modernization Program Pays. Braun Gear Corp. *Mill & Factory,* Vol. 18, Mar. 1936, pages 56-58, 122-128. In order to use in gear manufacture the latest tool steels and alloys and the tough, refractory raw materials now available, and to provide in addition quicker deliveries, higher accuracy and lower costs, a continuous modernization method was evolved. Capital investment and rapidity of amortization of individual lathe, gear cutters, etc. are discussed in considerable detail. FPP (4d)

5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

The Heat Treatment of Cast Iron. A. A. Timmins. *Proceedings Staffordshire Iron & Steel Institute,* Vol. 50, Session 1934/35, pages 121-128. The heat treating of cast Fe is, in some respects, similar to that of steel but the presence of Si, which causes instability of pearlite, will introduce modifications. Heat treatment is employed for cast Fe with the following objects in view: (1) The relief of casting stresses, (2) annealing to soften cast Fe, (3) heat treatment by quenching and tempering, (4) special heat treatments such as nitriding and shorterizing. GTM (5)

Working of Light Metal Alloys in the Electric Furnace (Verarbeitung der Leichtmetalllegierungen im elektrischen Ofen) Knoops. *Elektrowärme,* Vol. 6, Jan. 1936, pages 24-27. Curves are given which demonstrate the sensitiveness of Al and Mg alloys to temperature of heat treatment; each alloy has a certain best temperature which must be kept within ± 10° C. in order to obtain the best physical properties (Brinell hardness, tensile strength and elongation). Types of furnaces are described. Ha (5)

■ 5a. Annealing ■

Controlling the Rate of Heating. A. M. Steever & L. A. Lindberg. *Industrial Heating,* Vol. 3, Jan. 1936, pages 51-54. The importance of adjusting the proper rate of heating to the physical properties of the material to be heated is stressed and the bad effects of thermal lag in temperature measuring instruments are explained and methods of control to overcome discussed. Ha (5)

Application of Heat to Processing of Copper Alloys. R. S. Pratt. *Industrial Heating,* Vol. 3, Jan. 1936, pages 20-24. Heat treatment for hot working, homogenizing and annealing, necessity for temperature control and influence of the furnace type are discussed. Ha (5)

Various Applications of Oxy-Acetylene Flame (Les Applications Diverses de la Flamme Oxyacétylénique) *Revue de la Soudure Autogène,* Vol. 27, Dec. 1935, pages 4-9. Examples are given. FR (5)

Strain Annealing of Non-ferrous Metals. H. M. St. John. *Industrial Heating,* Vol. 3, Feb. 1936, pages 81-88. Season cracking is a defect peculiar to certain non-ferrous alloys when these have been worked into a wrought rather than a cast form. Causes, detection and means of overcoming it are discussed. This type of cracking occurs only when the metal is under strain; composition and shape of the metal are of great influence. A certain amount of intercrystalline corrosion must, however, be present for season cracking to occur. The mercurous nitrate test is the usual one to detect such cracks. Relief annealing at temperatures from 500° to 700° F. from ½ to 1 hr. is a cure for the defect. Ha (5a)

Bright-annealing Methods for Metals (Les Procédés de Recuit Clair des Métaux) L. Grangette. *Usine,* Vol. 45, Jan. 16, 1936, pages 29-31. Furnace types used in France are described. Ha (5a)

■ 5b. Hardening, Quenching & Drawing ■

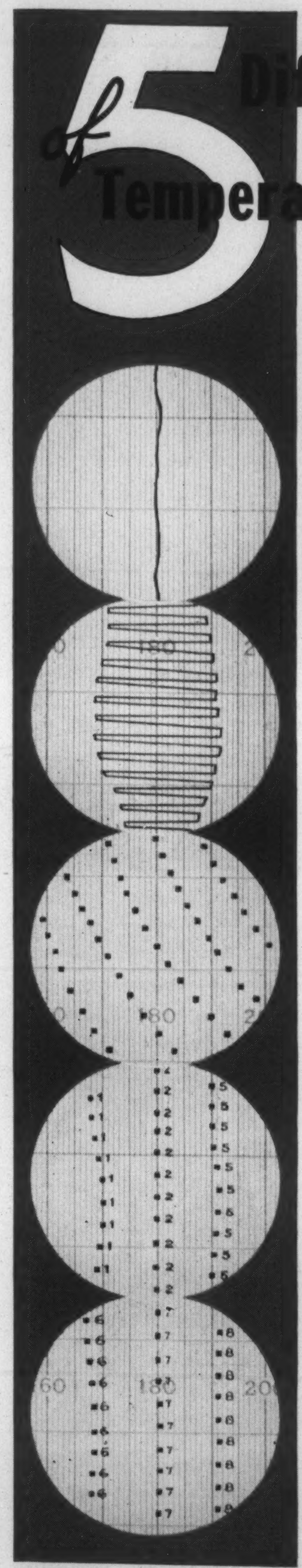
Heat Treatment of Aluminum Alloys. R. S. Archer. *Industrial Heating,* Vol. 3, Jan. 1936, pages 16-18; Feb. 1936, pages 90-94, 100. The theories about the hardening properties of Al alloys are explained, whereby 2 different hardening phenomena are recognized: (1) Pre-precipitation hardening which occurs on aging at room temperature after quenching from 1000° F., (2) precipitation hardening accompanied by actual formation of fine particles of the second constituent of the alloy which occurs on reheating for some hrs. at about 300° F. The properties of some Al alloys are given. The hardening effect of cold working can be removed by heating to 575°-675° F., very slow cooling is desirable. Solution heat treatment to bring the soluble constituents of the alloy into solid solution by rapid cooling to room temperature and precipitation heat treatment to produce further hardening after quenching are described. Ha (5b)

Heat Treatment of Cast Iron. J. E. Hurst. *Heat Treating & Forging,* Vol. 21, July 1935, pages 328, 337. Excerpt from presidential address before Institute of British Foundrymen. See "Surface Hardening Treatment Applied to Cast Iron," *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 58R/6. MS (5b)

High Standards are Maintained in Heat Treating Springs. J. E. Coleman. *Industrial Gas,* Vol. 14, Dec. 1935, pages 7-8, 25. A modernized installation for heat treating and temperature control is described. Ha (5b)

Use of "Electric Eye" in Industrial Process Control. R. A. Powers. *Steel,* Vol. 98, Mar. 2, 1936, pages 40-43. Among applications described is one for controlling temperature in a resistance-type heater, used for hardening tips of valve stems. Heating current is turned on 0.1 sec. after dies have located work. About 0.75 sec. is required to bring valve stem from room temperature to 1700° F. At correct temperature, heating current is turned off, and 0.1 sec. later, valve is released and falls into quench tank. Another application is checking actual height of bouncing hammer in scleroscope when making hardness tests. MS (5b)

Shielding Thin Sections of Punch to Reduce Hardening Strains. W. T. Koehler. *Machinery,* N. Y., Vol. 42, Mar. 1936, page 467. A light sheet-Fe shield of 0.01″ thickness is placed over the sections to be protected in hardening processes. Ha (5b)



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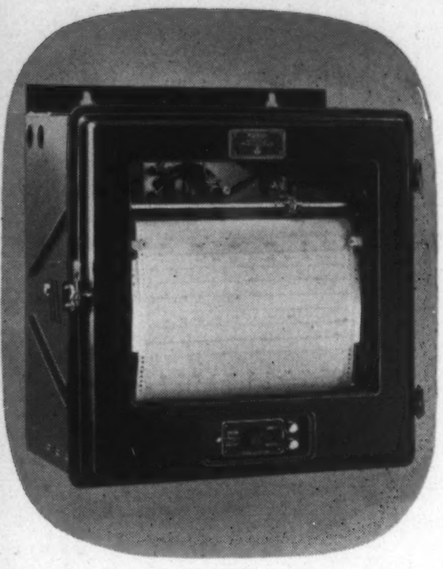

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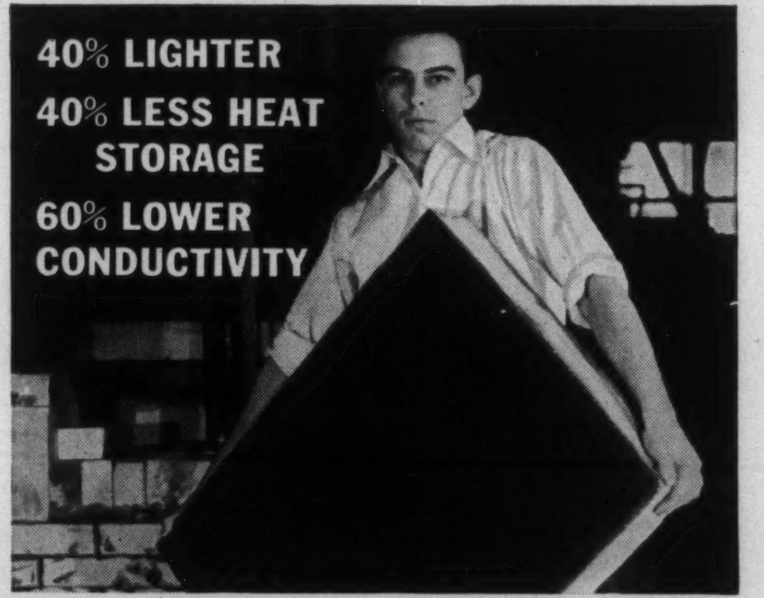
The Shorter-Double-Duo Process for Surface Hardening. *Engineering,* Vol. 141, Mar. 6, 1936, pages 273-274. **Local Surface Hardening.** *Machinery,* London, Vol. 47, Feb. 13, 1936, pages 601-604. Scope of this method has been extended and made applicable to pins and journals of crankshafts, rollers, and other parts of cylindrical form subjected to frictional wear. Describes procedure. The new development depends upon rapid application of heat, the rate of application being such that there is a limited accumulation of heat at outer surface sufficient to raise it slightly above Ac_3 critical point. Most crankshaft steels, provided they are straight hardening grades, may be treated by this new process. Gives analyses of suitable steels, and also results of tests. WB + VSP (5b)

Modern Developments in the Heat Treatment of Steel Rails. CECIL J. ALLEN. *Railway Gazette,* Vol. 64, Jan. 10, 1936, pages 56-63. The widely used Sandberg process for heat treating the heads of railroad and trolley car rails to produce the sorbitic structure is described. The process has recently been improved by increasing the water spray pressure during the first stage of the quench, instead of maintaining it constant. Actual treatment consists of the application of a "scotch mist" of water to the heated railhead, closely controlled as to time and pressure according to the shape and chemical composition of the railhead. Extensive tensile strength data show the uniformity of results obtained, and photomicrographs are included illustrating treated and untreated structures. The tensometer was used to measure exceptional yield stresses with highly satisfactory results. The comparatively low cost of the treatment in relation to the increased yield points and enhanced susceptibility to work-hardening, desirable for this application, are emphasized. FPP (5b)

Effect of the Wire Velocity in the Lead Quenching Process of Steel Wire on the Mechanical Properties of the Drawn Wire (Einfluss der Durchlaufgeschwindigkeit beim Bleipatentieren von Stahldraht auf die Festigkeitseigenschaften des gezogenen Drahtes) ANTON POMP & H. RUPPIK. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 17, No. 23, 1935, pages 259-274. The quality of a steel is improved by the process known as "lead-patenting" whereby the wire is heated in a continuous furnace to the required temperature and quenched in a lead bath immediately on leaving the furnace. The improvement in quality depends on the temperature with which the wire enters the lead bath and on the temperature which it acquires in passing through the bath. A steel wire of 0.66% C was used to study the conditions for different temperatures and velocities. It was found that a change in velocity in the bath very strongly influences the dependence of the mechanical properties on quenching and bath temperature. Good properties were obtained with 950° C. quenching and 450° C. lead bath temperature which constitute the highest and lowest permissible temperatures. The highest velocity still giving good results was 5 m./min. with which fairly uniform values of mechanical properties at different temperatures were obtained. 960° C. quenching and 560° lead bath temperature gave a pronounced optimum of properties at all velocities. Microstructural photographs and test curves for all conditions in the experiment are reproduced. 14 references. Ha (5b)



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Intensity and Penetration of Hardness in Nickel-chromium Steels with Low Carbon Content (Intensita e Penetrazione di Tempere in Acciai al Nichel-Cromo a Debole Tenore in Carbonio) T. NATALE. *Industria Meccanica,* Vol. 18, Feb. 1936, pages 59-63. Curves were taken with 2 Ni-Cr steels containing only 0.15% C to find how deeply the hardening effect by quenching from different temperatures penetrates and what effect different temperatures of subsequent drawing has. At the same time, the velocity of cooling was determined and found to be the greater the higher the initial temperature. Cooling is at first fairly rapid and then slows down. Ha (5b)

Heat Treatment of Packard "120" Automobile Parts. J. B. NEALEY. *Industrial Heating,* Vol. 3, Mar. 1936, pages 173-174. Cyaniding baths and gas fired carburizing muffles, and the installations to treat small automobile parts with the least possible handling are described. Ha (5b)

Heat Treatment of Cast Iron. R. G. MCELWEE. *Transactions American Foundrymen's Association,* Vol. 6, Dec. 1935, pages 27-38. The author discusses the practical heat treatment of cast Fe from 3 angles, first for lowering hardness, second for increasing hardness, and third, controlling hardness by special irons. Under the second heading Fe of martensitic structure and its application for various types of castings are discussed. Under special irons the author uses as an example one containing approximately 2.5% C, 1.5% Si, and Mn 0.35%. This Fe is cast white and on heat treating produces a tensile strength of 90,000 lbs./in.^{2}, an elastic limit of 70,000 lbs./in.^{2}, with an elongation of approximately 4% and a hardness of 235 Brinell. CMS (5b)

5c. Aging

Aging of Steels (Le vieillissement des aciers) ALBERT SAUVEUR. *Revue de Métallurgie,* Vol. 33, Feb. 1936, pages 85-88. A brief summary of the theories accepted at present. JDG (5c)

Aging of Steel (Le vieillissement de l'acier) J. GALIBOURG. *Revue de Métallurgie,* Vol. 33, Feb. 1936, pages 73-84. Summary of the contemporary views on the subject. JDG (5c)

5d. Malleablizing

The Economy of Rapid Malleablizing in the Electrically Heated Malleablizing Furnace (Die Wirtschaftlichkeit des Schnelltemperns im elektrisch beheizten Temperöfen) R. BUCHKREMER. *Giesserei,* Vol. 23, Jan. 3, 1936, pages 1-4. Experiments established the superiority of the electric furnace for malleablizing of Fe. The material always showed uniform quality and absolute reliability in the desired degree of malleablizing by automatic temperature regulation and eventually also control of atmosphere. The costs were greatly reduced by lower labor costs. Ha (5d)

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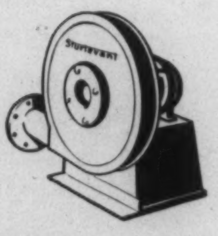

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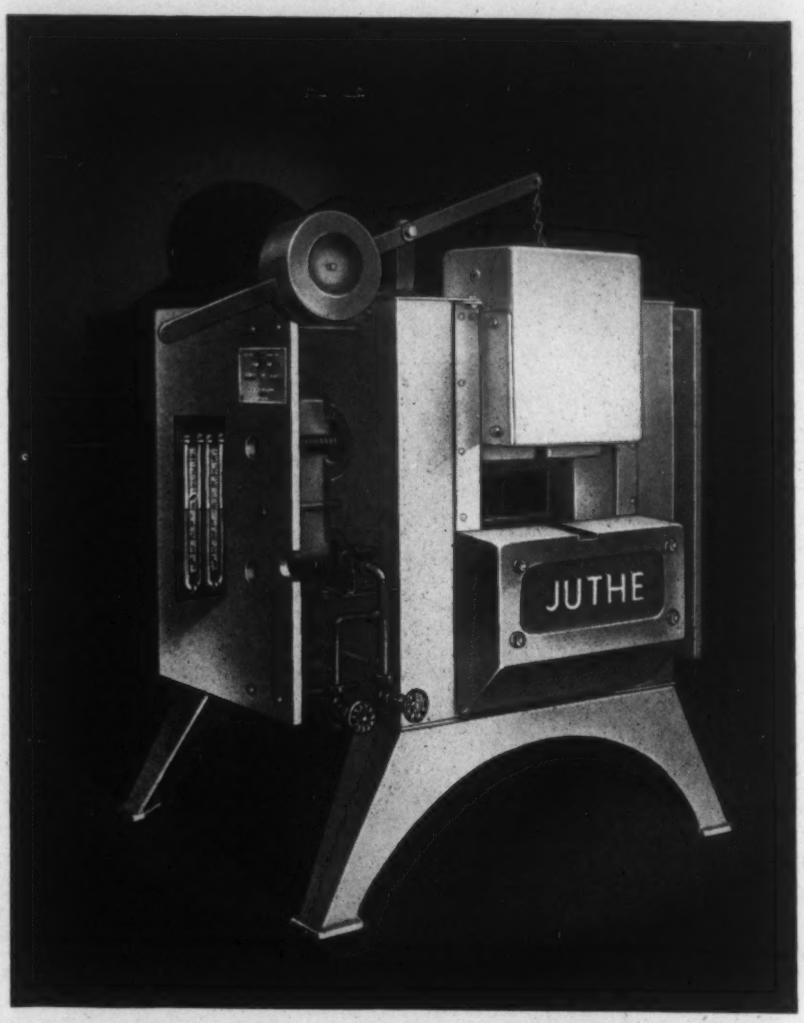

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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Improving Open-Hearth Furnace Design. WILLIAM C. BUELL, JR. *Steel*, Vol. 96, June 3, 1935, pages 56-58; June 10, 1935, pages 52-53, 55-56; June 17, 1935, pages 49-50, 52; June 24, 1935, pages 50, 52, 54; Vol. 97, July 1, 1935, pages 40-42, 44, 46; July 8, 1935, pages 50, 52-53; July 15, 1935, pages 57-58, 60-61; July 22, 1935, pages 45, 47-48; July 29, 1935, pages 40, 42-43, 44; Aug. 5, 1935, pages 58, 61-62; Aug. 12, 1935, pages 54-56; Aug. 19, 1935, pages 44, 46, 49-50, 52; Aug. 26, 1935, pages 45-46, 48, 50; Sept. 2, 1935, pages 63-64, 66-67; Sept. 9, 1935, pages 53-55; Sept. 16, 1935, pages 44-45, 47; Sept. 23, 1935, pages 81-82, 84, 86; Sept. 30, 1935, pages 38-42; Oct. 7, 1935, pages 53-54, 56, 58, 61; Oct. 14, 1935, pages 55-57; Oct. 21, 1935, pages 54-55, 57-58; Oct. 28, 1935, pages 46-48, 50; Nov. 4, 1935, pages 58, 60, 62; Nov. 11, 1935, pages 56-57, 60, 63-64; Nov. 18, 1935, pages 60, 63-64; Nov. 25, 1935, pages 47, 49, 52, 54-55; Dec. 2, 1935, pages 50-51, 53; Dec. 9, 1935, pages 38-40; Dec. 16, 1935, pages 53, 55-56; Dec. 23, 1935, pages 45-46, 48, 54. Continues series previously published in *Steel*, Vol. 91-93 (*Metals & Alloys*, Vol. 5, Apr. 1934, page MA 138). Detailed treatment of that part of the furnace below the charging floor. Describes details of typical installations, discusses principal factors to be considered in design and presents methods of designing system along more efficient lines. Shows importance of correct lay-out of auxiliary system collectively and of the several components individually. Considers structural design of steel and brick-work of slag-pockets, fantails, and regenerators. Pays much attention to economies of refractories and insulation. Describes methods of determining sizes of the various critical areas to effect optimum control of flow of the gases. Discusses features of single and multiple pass regenerators of both the vertical and horizontal types, checker-brick designs, method of laying brick, connecting flues, and heat transfer in the regenerators. Presents graphic methods of solving heat transfer problems and applies them to design of checker passes and flues. Treats of design and construction of butterfly, H_2O-sealed, and slide-valves; and construction, design, operation, and economics of waste-heat boilers. MS (6)

A Graphical Method of Calculating Heat Loss Through Furnace Walls. CLARENCE F. WEINLAND. *Journal American Ceramic Society*, Vol. 19, Mar. 1936, pages 74-80. Discussion of thermal conductivity data in form of true conductivity. Graphical solution of problems in equilibrium heat flow is shown and theoretical background is discussed in detail. A typical problem is solved by the new method. See also *Metals & Alloys*, Vol. 6, Sept. 1935, page MA 360R/9. WB (6)

Solid Reactions at 1000° to 1200° C. Between MgO or BeO and Ni, Fe, Cr, Mn and Their Oxides. LOUIS NAVIAS. *Journal American Ceramic Society*, Vol. 19, Jan. 1936, pages 1-7. Problem was initiated because of possibility of reaction of Ni-Cr resistance wire and Ni-Cr-Fe metal sheath in some types of tube furnaces with the MgO or BeO refractory packed between the sheath and resistance wire. Tests were made with oxide powders in contact with MgO and BeO and heated in dry air, dry N_2 and wet air and wet N_2. The reactivity of the oxides was determined by the coloration produced on the refractory; the order of reactivity being found to be Ni, Fe, Cr, Mn, the last being the most reactive oxide. Fe and Cr were about par for both MgO and BeO and Ni oxide showed no reaction with BeO. The BeO was less affected than MgO in all cases. The reaction of the metals with the refractories paralleled the behavior of the oxides, except that in oxidizing atmosphere the extent of the reaction, elementary metal-refractory oxide is greater than when the metallic oxides are in contact with refractory thus leading to the finding that the process of oxidation increased the rate of reaction of the underlying oxide with the refractory. Tests were made in H_2 at 1200° C. with metals and metal oxides, of the oxides Mn alone showed slight reaction, of the metals Cr and Mn alone showed slight reaction. Binary, 50-50, alloys of the individual metals and a ternary, Ni-Fe-Cr, alloy were also tested and showed less reaction than the single metals. Greater reactivity was found for wet air than for dry air. WB (6)

Developments in Chemical Apparatus. Electric Furnaces, Parts 5 and 6 (Fortschritte des chemischen Apparatewesens. Elektrische Oefen, Lieferungen 5 und 6) Edited by ADOLF BRÄUER & JOSEF REITSTÖTTER. Akademische Verlagsgesellschaft, Leipzig, 1936. Paper, 7½ x 11½ inches, Part 5, pages 177-192, 449-592, Part 6, pages 193-236, 593-656. Price each part 28 RM, whole volume, to subscribers, 132 RM.

These two parts complete vol. 1, completing the abstracts of German patents on electric furnaces through No. 540, 969, and through 1931.

There are two pagings, one for a general classification with references to the patent numbers concerned, the other for the patent abstracts themselves in numerical order.

The whole volume is a very complete and handy collection. The patents are so fully abstracted that, in patent searches to reveal the German art, much of the work could be done directly from this book. The specification is usually condensed, the claims given in full, one or more important figures reproduced and information given as to the number of illustrations shown in the original.

H. W. Gillett (6) -B-

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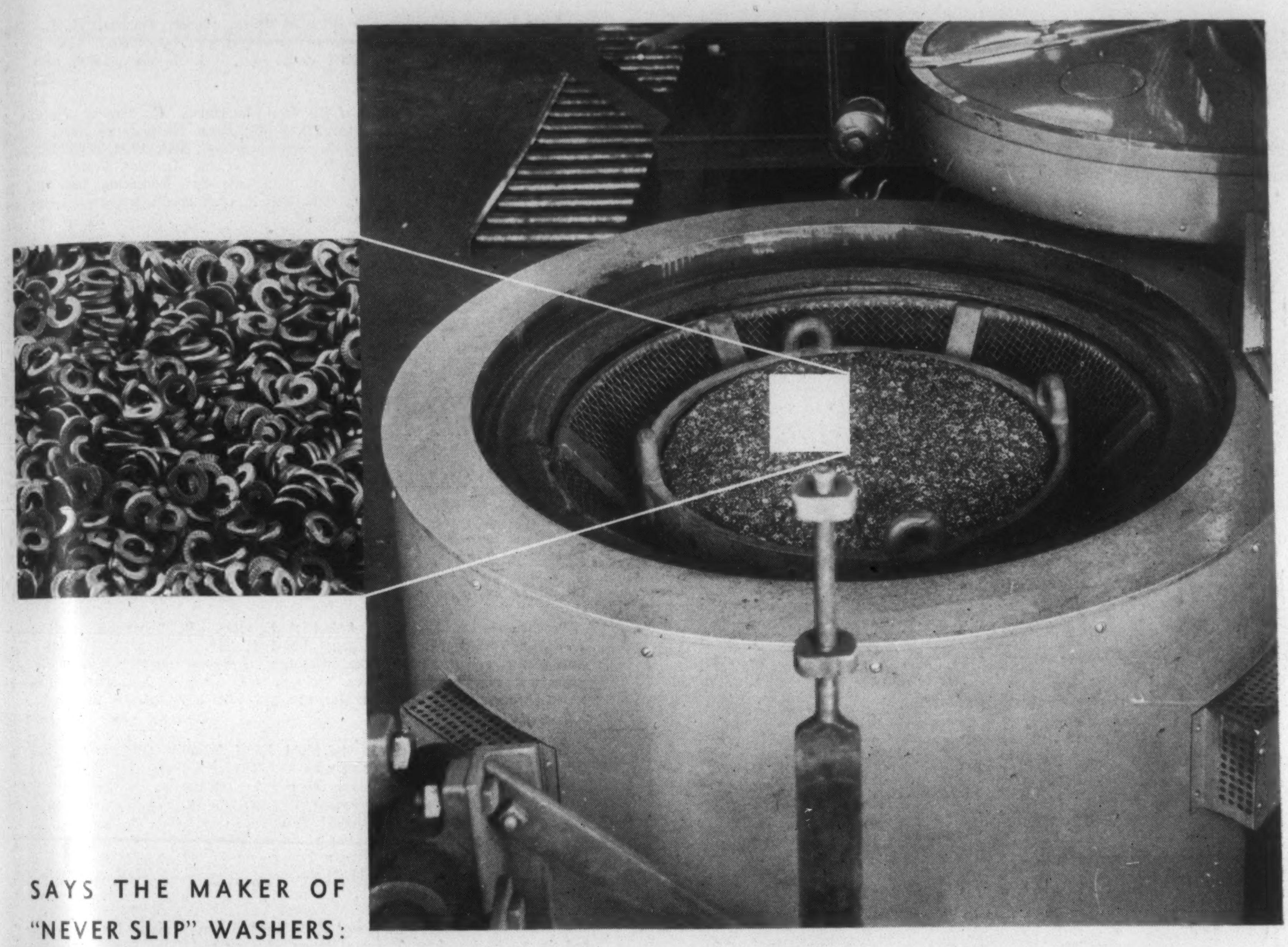

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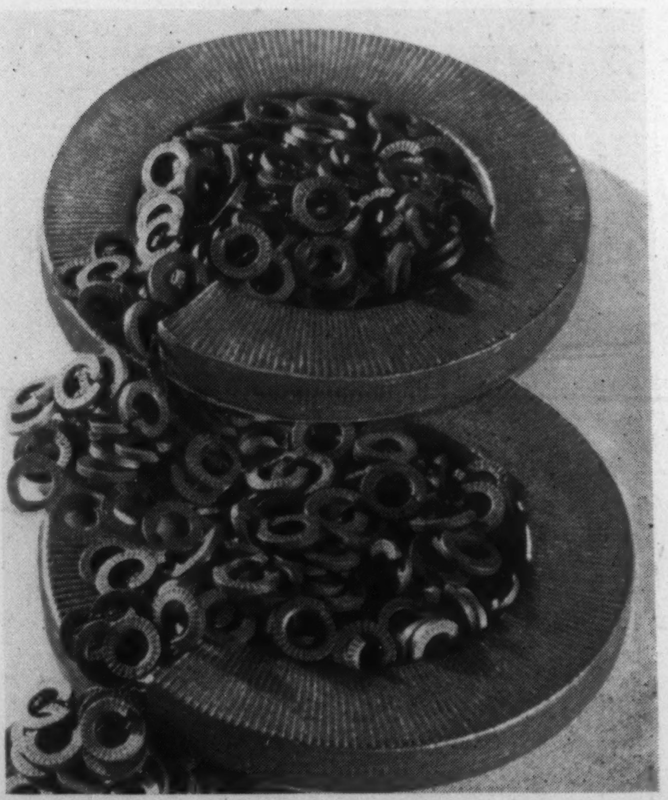

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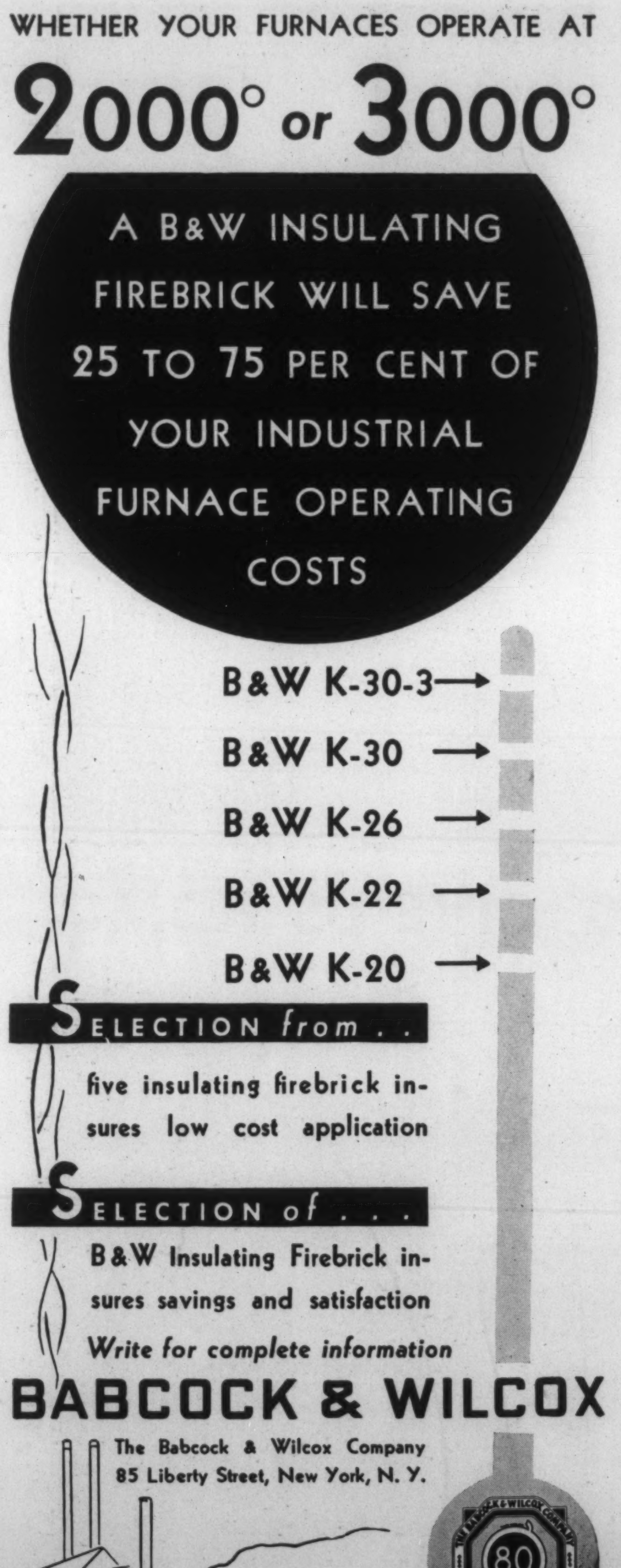

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R-36

Some Uses of Insulating Fire Brick in Modern Foundry Practice. C. L. Norton, Jr. *Transactions American Foundrymen's Association*, Vol. 6, Dec. 1935, pages 55-58. See *Metals & Alloys*, Vol. 7, Mar. 1936, page MA 122L/2.
CEJ (6)

Refractory Problems in Basic Alloy Steel Production. G. Soler. *Industrial Heating*, Vol. 3, Mar. 1936, pages 189-192; *Blast Furnace & Steel Plant*, Vol. 24, Jan. 1936, page 106; Feb. 1936, page 186; Mar. 1936, pages 265-266. From paper read before Refractories Division of the American Ceramic Society. Factors determining the selection of refractories and influencing their life in steel plant service are discussed, conditions in open hearth furnaces, electric arc furnaces and ladle linings are considered.
Ha + MS (6)

Possibilities and Difficulties of Air and Gas Measurements by the Inoculation Process (Die Möglichkeiten und Schwierigkeiten der Luft- und Gasmengenmessung nach dem Impfverfahren) G. Neumann. *Archiv für das Eisenhüttenwesen*, Vol. 9, Oct. 1935, pages 179-183. The inoculation method although advantageous where other methods are uncertain still needs further development; the method is somewhat costly. It is quite precise, however, and is thus suitable for calibration though not for routine analysis.
Se (6)

Forging and Heat Treating Locomotive Parts. J. B. Nealey. *Steel*, Vol. 98, Mar. 23, 1936, pages 32-35. Describes shops of Pennsylvania Railroad at Altoona, Pa., with chief attention to furnaces. All furnaces are gas fired. Blacksmith shop 1 has 2 3-chamber forging furnaces, 2 2-chamber drop forge furnaces, and 7 single-chamber forging furnaces. Wrought-Fe scrap is reclaimed by blooming into billets, which are then drop forged into various parts. Blacksmith shop 2 has 6 drop-hammer furnaces, 18 smaller furnaces for swing-belt hammers and forging-machines, and 6 car-bottom and 4 cylindrical vertical furnaces for heat treating. Car-bottom furnaces are used for annealing prior to machining. Hardening is done in both the cylindrical, vertical and car-bottom types. Carburizing is carried out in 2 single-door, box-type furnaces. Boiler-shop has 2 large double-end furnaces for heating heavy plates.
MS (6)

Recuperation as Applied to Industrial Furnaces. B. Sampson. *Industrial Heating*, Vol. 3, Feb. 1936, pages 102-104; Mar. 1936, pages 161-164. The principles of recuperation and the advantages in economy due to preheating of gas and air in the combustion process are explained. Increased production and better working conditions around a furnace equipped with a recuperator described.
Ha (6)

Electric Melting Furnaces in the Light Metal Industry (Elektroschmelzöfen in der Leichtmetallindustrie) U. Schwedler. *Elektrowärme*, Vol. 6, Jan. 1936, pages 20-24. Most important types of electric furnaces for the melting of light metals are crucible, tank and induction furnaces. The particular advantages of each type with regard to the metallurgical behavior of the melt and the absorption of gases are discussed and the economy of an oil heated tank furnace, an electrically heated tank furnace, and an induction furnace for a daily capacity of 5 tons compared. The melting cost per ton of Al was found to be 37.60, 37.30 and 27.40 RM. respectively for these 3 types.
Ha (6)

A Discussion on the Report on "Waste Heat Boilers in Open Hearth Practice." Led by A. F. Webber. *Journal West of Scotland Iron & Steel Institute*, Vol. 48, Part 1, Oct. 1935, pages 3-12. The procedure and results of the Park Gate test are described. The construction and advantages of the Spanner thimble tube boiler and of the Sinuflo fire tube boiler are described. The use of a water tube boiler is compared to that of fire tube boilers. A properly designed economizer will lower the temperature 55° to 80° C. The results of the test are not representative of ideal conditions because the gas temperature and flow were less than the boiler was designed for and because the producer gas was not of the most desirable composition especially with respect to moisture content (38.7 grains/ft.^{3}). They are considered representative of what may be expected because frequently the amount and temperature of the gases is actually less than allowed for in the design.
FGN (6)

Automatic Combustion Control for Furnaces and Boilers Improved. E. W. Wagenseil. *Steel*, Vol. 98, Feb. 17, 1936, pages 54, 65. Automatic combustion control equipment available at present for metallurgical furnaces and boilers is far superior to that offered prior to depression. Installation of such equipment on existing furnaces and boilers would effect improvement in operation and reduction in costs.
MS (6)

Pulverized Fuel Firing for Metallurgical Purposes. Harold E. Cookson. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 50, Session 1934-35, pages 1-68. See *Metals & Alloys*, Vol. 6, June 1935, page MA 228R/4.
GTM (6)

Economical Operation of Induction Furnaces. Franz Pölzguter. *Steel*, Vol. 98, Jan. 27, 1936, pages 30-35. See "Construction and Use of Induction Furnaces for Steel Making," *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 494R/7.
MS (6)

Foundrymen and the Electric Furnace. A. G. Robiette. *Electrical Review*, Vol. 118, Feb. 14, 1936, pages 247-248. See "The Electric Furnace in the Non-Ferrous Foundry," *Metals & Alloys*, Vol. 7, Feb. 1936, page MA 62R/2.
MS (6)

Experiences in the Use of Refractories in the Steel Plant. L. A. Smith. *Brick & Clay Record*, Vol. 88, Jan. 1936, page 32; *Blast Furnace & Steel Plant*, Vol. 23, Dec. 1935, page 882. De-aired refractories, suspended arches, shape elimination and standardization, and the classification of fireclay brick are discussed.
CBJ + MS (6)

Performance of Refractories Used in Basic Alloy Steel Production. Gilbert Soler. *Brick & Clay Record*, Vol. 87, Dec. 1935, pages 206-208. **Refractory Problems in Basic Alloy Steel Production.** *Heat Treating & Forging*, Vol. 21, Nov. 1935, pages 544-545; *Steel*, Vol. 97, Dec. 2, 1935, pages 45-46. Refractories are being improved to prevent non-metallic inclusions in the steel. Points of greatest wear on the refractories in both open hearth and electric furnaces and the best types of refractories for these locations are discussed.
CBJ + MS (6)

Note on the Failure of a Gold Fuse in Contact with Nickel-chromium Alloy. M. C. Caplan. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 197-198. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 451R/3. (6)

Forging at the Columbia Tool Steel Company. R. J. Jamison. *Heat Treating & Forging,* Vol. 22, Jan. 1936, pages 16-17. **Gas-Fired Forging Furnaces.** W. G. Gude. *Steel,* Vol. 98, Feb. 3, 1936, pages 48, 50. At the Chicago Heights plant, 4 furnaces were converted to gas firing. Insides were redesigned and rebricked. Each furnace is equipped with 3 low-pressure sealed-in burners of special design mounted in a specially constructed combustion chamber. Each furnace is equipped with 2-position gas and air mechanical positive proportioning valves. Controls include continuous gas analysis recorder for each furnace, highly accurate furnace pressure-gages, and gas pressure regulators. Crew foreman determines heating program for a given charge. By controlling furnace atmosphere, surface decarburization has been reduced 66⅔% and scaling, 75%. Use of relatively high positive furnace pressure assures uniformity of the product. Firing speed has been increased 500%. Danger of overheating or underheating work has been eliminated. Thermal efficiency of furnaces was increased about 50%. MS (6)

New Electric Furnaces in the Solingen Industry (Neue Elektroöfen in der Solinger Industrie) K. Mertens. *Elektrowärme,* Vol. 6, Mar. 1936, pages 102-103. Electric furnaces especially developed for the heat treatment of cutlery of alloy and rustless steels are described. Ha (6)

New Open-hearth Checker Increases Efficiency of Regenerator Chambers. M. K. Mellott. *Iron Age,* Vol. 137, Mar. 19, 1936, pages 44-45. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 125L/3. VSP (6)

Electric Furnaces. W. S. Gifford. *Iron & Coal Trades Review,* Vol. 132, Mar. 20, 1936, page 529; *Electrical Review,* Vol. 118, Mar. 20, 1936, page 423. A brief review is given of the spreading use of electric furnaces in British metallurgical industries. Normal frequency induction furnaces are used for production of brass; for melting small quantities of bronze and cast Fe the rocking arc and the rocking resistor furnace are employed, the latter having a graphite resistor rod. Surface hardening of crankshafts and similar parts was carried out by heating with a current of 2000 cycles and rapid quenching by water squirted through the hollow induction coils; the whole cycle takes only 45 sec. Ha + MS (6)

Electric Furnaces and Their Industrial Use (Les fours électriques et leurs emplois industriels) *Journal du Four Electrique,* Vol. 45, Feb. 1936, pages 58-59. General. JDG (6)

New Electric Induction Furnace (Nouveaux fours électriques à induction) *Journal du Four Electrique,* Vol. 45, Feb. 1936, page 57. Account of performance of a furnace developed by Halasz and Fekete using 100 volts 25 cycles current. The one ton furnace used for steel had an uncorrected power factor 0.50-0.60 and melted the charge in 90 min. with the power supply of 400 kw. hr. High frequency transformer or condenser batteries are not required. Structural details not given. JDG (6)

Open-Hearth Checker Increases Efficiency of Regenerator Chambers. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 84-85. See "Designs New Checker for Regenerator Chambers," *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 125L/3. MS (6)

Metal Decorating Oven Built to Turn Out Exacting Work. *Steel,* Vol. 98, Feb. 24, 1936, pages 46, 48, 68. Describes conveyor oven, which is divided into several controlled zones, the number depending upon its length. Each zone has its own circulating fan, thermostatic control, and distributing duct work. Hood at loading zone prevents escape of volatile compounds and hot air into room. Cooling section is provided at end of hot zone. Source of heat is an air heater of either the direct or indirect type. Gas or oil-burners may be used. MS (6)

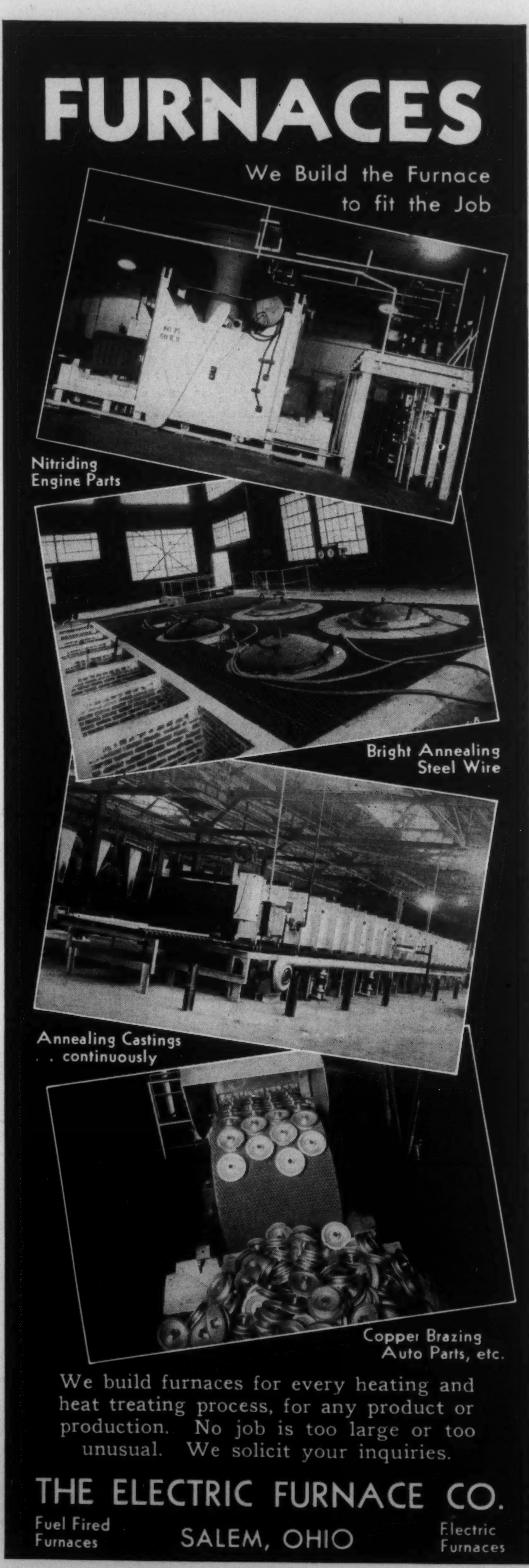
The Use of Penetrating Radiations in the Measurement of the Porosity of Refractory Brick. J. B. Austin. *Journal American Ceramic Society,* Vol. 19, Feb. 1936, pages 29-36. Measurements of X- and γ-ray absorption to determine porosity show the method is entirely practical. There is a slight advantage in use of γ radiation but in either case the method produces better results and more rapidly than present displacement tests. Theoretical discussion of factors involved and results reviewed in text, in tables and a few curves for various refractories. Description is given of the Failla vacuum-tube potentiometer with which the tests on porosity were made. WB (6)

Cupola Furnace Practice with Saar Coke (Aus der Kupolofen praxis mit Saarkoks) Karl Bäsel. *Giesserei,* Vol. 23, Feb. 14, 1936, pages 77-78. Coke from Saar coal which was considered unsuitable for use in cupola furnaces can be used if the blast is properly adjusted; section of nozzles to section of furnace should be 1:8 to 1:10. An advantage is its low S content and easy reaction. Best conditions of use are discussed. Ha (6)

A New Method for Studying the Flow Characteristics of Glasses and Slags at Elevated Temperatures. Elliott P. Barrett & James A. Taylor. *Journal American Ceramic Society,* Vol. 19, Feb. 1936, pages 39-44. Present methods of determining absolute values of viscosity and surface tension of glasses and slags are discussed and shown to be unnecessary in that relative values only are required. The new method is easily carried out and gives reproducible results which are relative values. WB (6)

Loading Device for Load-Test Furnace. John L. Carruthers. *Journal American Ceramic Society,* Vol. 17, Feb. 1936, pages 36-38. Discussion, description and detail-drawings of the new testing device to obtain high temperature load-carrying characteristics of refractory brick. WB (6)

The "Low-Down" on the Theories of Heating. *Industrial Heating,* Vol. 3, Jan. 1936, pages 11-15, 25. In a rather humorous manner the author approaches the problem of calculating heating processes, e.g. how long it will take to heat a bar, or the heat distribution within a bar at any time. Starting from the Fourier series a number of curves which can be used for practical purposes are developed without any higher mathematics. Ha (6)



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Improved Vertical Hot Tube Annealers. LEE WILSON. *Blast Furnace & Steel Plant,* Vol. 23, Dec. 1935, pages 854-855, 858; *Heat Treating & Forging,* Vol. 21, Nov. 1935, pages 539-541; *Steel,* Vol. 97, Dec. 9, 1935, pages 36-37; *Iron Age,* Vol. 136, Nov. 21, 1935, pages 26-29. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 122R/3. MS + VSP (6)

Utilization of Coke-Oven Gas in Metallurgical Works (Die Verwertung des Koksofengases auf Hüttenwerken) W. EILENDER *et al. Stahl und Eisen,* Vol. 55, Oct. 31, 1935, pages 1153-1164. Report of a symposium on the general problems of the utilization of coke-oven gas in the iron and steel industry. SE (6)

Application of Gas-Fired Radiant Tubes to Porcelain Enameling. E. F. GEHRIG. *Iron Age,* Vol. 137, Feb. 6, 1936, pages 26-29. Describes the new method of heating of enameling furnaces by the Detroit Michigan Stove Co. The furnaces are heated by gas fired radiant tubes in a manner similar to the way electric heating elements are used. The conversion merely entailed the removal of furnace muffle and substitution of radiant tubes. VSP (6)

Results of Experiments with Cokes from Coal of Different Geological Origin in the Cupola Furnace (Versuchsergebnisse mit Koks aus Kohle verschiedener geologischer Herkunft im Giessereischachtofen) W. HOLLINDERBÄUMER. *Giesserei,* Vol. 23, Jan. 31, 1936, pages 73-77. The suitability of a certain kind of coke in a cupola depends principally on the construction and combustion process of the cupola. Foundry coke should have small pores, and the graphitization of the C in the coke should not exceed definite limits which, however, have not been definitely determined so far. Test results with several kinds of coke are given. Ha (6)

Heating, Quenching and Drawing Mechanized by New Furnace Unit. H. M. HEYN. *Industrial Gas,* Vol. 14, Feb. 1936, pages 13, 16, 24. A gas-fired furnace is described in which the 3 operations are combined with practical elimination of scaling. The furnace handles automatically 40 rear axle shafts (for automobiles) per hr. Ha (6)

Malleable Furnace Refractories. L. C. HEWITT. *Transactions American Foundrymen's Association,* Vol. 6, Dec. 1935, pages 51-54. A definite advance has been made in recent years in the development of refractories and their application in malleable furnaces. Bung brick have been improved particularly in respect to spalling action. Side wall life has been improved through the use of super fire clay brick and high temperature mortar. Tapout blocks of super fire clay type have also come into use. Fire brick bottoms laid with cold set high temperature cement are rapidly gaining in favor. CMS (6)

Fused Magnesia. BURROWS MOORE & W. L. PATRICK. *Industrial Chemist,* Vol. 11, Aug. 1935, pages 318-320. Review of some of the physical and chemical properties of electrically fused magnesia which is now being prepared on a commercial scale. RAW (6)

Steelworks Furnace Equipment. H. SOUTHERN. *Iron & Coal Trades Review,* Vol. 132, Jan. 17, 1936, pages 131-132. Trends of progress in design of ingot and billet reheating furnaces, continuous reheating furnaces, forging furnaces, furnace equipment and outlook are discussed. Ha (6)

Experiences in the Use of Refractories in the Steel Plant. LOUIS A. SMITH. *Industrial Heating,* Vol. 3, Jan. 1936, page 34. De-aired refractories have lately been made and appear to be very useful. Recent structural features in design of furnaces are discussed. Ha (6)

Some Uses of Refractory Materials in the Foundry. J. G. A. SKERL. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 566-592. See *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 301; Dec. 1933, page MA 399. CEJ (6)

Electric Furnace in Continuous Manufacturing Operations (Der elektrische Ofen für Fliessbetrieb) G. SIMON. *Elektrowärme,* Vol. 6, Feb. 1936, pages 159-164. The advantages of the electric furnace, both of the batch and the continuous type, to fit in any place in series manufacturing operations are explained. It is especially profitable for quantity production, the continuous type being still more economical than the batch type electric furnace. Selection of furnace type, dimensions, and conveyors for the material are discussed, and examples of metallurgical and ceramic furnaces described. Ha (6)

Developments and Trends in Refractories. LOUIS J. TROSTEL. *Blast Furnace & Steel Plant,* Vol. 23, Sept. 1935, pages 621-622, 624-625, 632; Oct. 1935, pages 703-705, 720; Nov. 1935, pages 775-776; *Heat Treating & Forging,* Vol. 21, Aug. 1935, pages 391-393; *Iron Age,* Vol. 136, Nov. 21, 1935, pages 18-21, 90, 92, 94; Dec. 5, 1935, pages 26-29, 95. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 122L/4. MS + VSP (6)

Everyday Applications of Insulating Firebrick. M. J. TERMAN. *Industrial Heating,* Vol. 3, Jan. 1936, pages 31-33; Feb. 1936, pages 121-124, 126. The advantages of insulating firebrick over heavy refractories in the metallurgical and ceramic industries as lining material are pointed out. They can be used up to 2950° F. except in places where mechanical abrasion and slagging conditions prevail. Tables of physical and mechanical properties are given, and a few installations with operating data described. Ha (6)

Cupola Refractories. *Foundry Trade Journal,* Vol. 53, Aug. 29, 1935, pages 145, 147. Discussion of paper on "Refractories for Foundry Use," by W. J. Rees (see *Foundry Trade Journal,* July 18, 1935, pages 47, 48; abstract in *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 62R/4). Jointing cements, blast-furnace linings, ground ganister, cases of over-insulation, refractory cements are discussed. With regard to the problem of C deposition, which occurred in the cooler parts of the cupola, and was sometimes noted in blast-furnace work, if by any oversight one used refractories in which there was a quantity of iron oxide, Turner said it was astonishing how much C could be deposited in those circumstances. A little globule of Fe was reduced and it continued to act upon CO so that more and more C was deposited until, if the process were allowed to proceed, the C became very much more bulky than the original brick on which it had been deposited. AIK (6)

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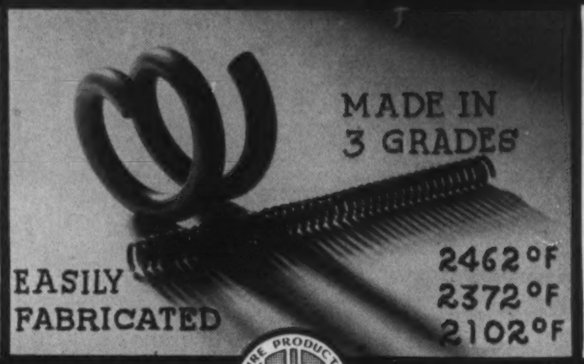

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Repairs to Linings of Steel Furnaces. *Engineering,* Vol. 141, Feb. 21, 1936, pages 216-217. Briefly describes a few repairs which can be made successfully while the open-hearth steel furnace is in operation. Door jambs can be repaired by moving the door sufficiently to one side while the old jamb is cut out. Loose bricks are put in to fill up the open space leaving just enough room to work on the jamb. The bricks are soaked in boiling tar to prevent chipping when they are exposed to the heat of the furnace. Dolomite which has been freed from fine powder and large lumps is used for repairing holes in a basic hearth. All metal must be completely removed before such repairing can be done. Roof patching can be done by laying bricks over the weak section which is satisfactory until the charge has been tapped and more permanent repairs made. Cavities in the back lining should be filled in with magnesite or chromium-ore powder. LFM (6)

Refractories for Smelting White Metals. EDMUND R. THEWS. *Metal Industry,* London, Vol. 47, Aug. 16, 1935, pages 154, 156. This article has been condensed and adapted to English conditions from a paper that appeared in *Tonindustrie Zeitung.* Fireclay bricks, containing 36-46% Al, are used in lining furnaces used for melting white metal and for recovery of residues. They are found to be more economical than basic bricks. The destruction of the hearth and leakage through the hearth or occasionally through the sides of the furnace are the major difficulties encountered in smelting these metals. Various methods of avoiding the weakness of joints, a common cause of low durability, are indicated. An efficient but expensive method of preventing leakage through the bridge is also outlined. HBG (6)

Deblanchal Rotary Melting Furnace. C. F. HERINGTON. *Blast Furnace & Steel Plant,* Vol. 24, Feb. 1936, pages 153-156. *Heat Treating & Forging,* Vol. 22, Feb. 1936, pages 93-96. Describes furnace for melting gray and malleable Fe, steel, non-ferrous metals, and alloys. Consists of cylindrical section made of heavy steel plate. Preheated air inlet, to which is attached the fuel burner, is provided at one end of furnace and is movable to 1 side to facilitate charging. Furnace rotates at a speed of 1 r.p.m. Combustion air is preheated to 500° F. in a recuperator having a slag chamber. Most industrial fuels of high calorific value may be used, fuel-oil being preferred. Furnace can be charged in 15-20 min. Time required to produce a melted charge, using preheated air and fuel-oil is about 70 min. Most satisfactory lining is a monolithic rammed lining. Pyrometers are provided for each end of furnace. This type of furnace is built in capacities of ½-12 tons. Comparison of costs of melting Fe using fuel-oil in Deblanchal furnace with tilting-type rotating furnace using pulverized coal, shows investment cost per ton of $0.32 and fuel cost per ton of $0.69 for former and $0.80 and $1.38 respectively for latter. Other advantages are simplicity in operation; low oxidation loss; wide range of products; high temperature of pouring Fe; adaptation of furnace to duplexing; freedom of metal from slag; accurate control of product; lower power consumption; and faster melting. MS (6)

The Slag Resistance of Steelworks Refractories. *Engineering,* Vol. 141, Jan. 31, 1936, page 134. From a paper read before the Refractory Materials Section of the Ceramic Society, London, Nov. 1935. LFM (6)

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7. JOINING

■ 7b. Welding & Cutting ■

E. V. DAVID, SECTION EDITOR

Precautions for Welding in Unventilated Places. H. F. Reinhard. *Industry & Welding,* Vol. 8, Mar. 1936, pages 15-17, 25-28; *Steel,* Vol. 98, Mar. 2, 1936, pages 48, 50, 52. From paper presented before National Safety Council. Explosion dangers attending welding in badly ventilated rooms are explained and precautions to be used when welding gas tanks, etc. are discussed.
Ha + MS (7b)

Safe Rules Relative to Arc Welding (Prescriptions Relatives à la Soudure à l'Arc) *Revue de la Soudure Autogène,* Vol. 28, Jan. 1936, pages 10-11. Gives at length safe rules established by "Institut de Soudure Autogène" in connection with "Société des Ingénieurs Soudeurs." FR (7b)

Saw Welding. Owen C. Jones. *Industry & Welding,* Vol. 8, Mar. 1936, pages 21-25. Procedure in welding saws is described. Ha (7b)

Physical Properties and Structure of Gas Fusion Welds (Physikalische Eigenschaften und Gefügeausbildung bei Gasschmelzschweissungen) F. Leitner & Alfred Schmidt. *Autogene Metallbearbeitung,* Vol. 29, Feb. 1, 1936, pages 33-37. Experiments with specimens of pure welds, that is, specimens made of a V-weld in several layers, have proved that the physical properties of an autogenous weld are closely connected with the kind of structure formed in the weld. O and N exert only a minor effect in gas welds. A Mn-Ni alloyed welding rod gives better properties than an ordinary ingot Fe rod; it should be applied in high-stress welds where no stress-relief by annealing is used. Such annealing improves the notch-toughness in all cases. Annealing at 600° C. does not produce noticeable changes in the structure and notch-toughness of a gas weld. A subsequent heat treatment with the torch above Ac_3 after preceding cooling of the weld below Ac_1 brings about similar improvements in structure and notch-toughness as normalizing. The advantages of alloy welding rods are described and illustrated by photographs of structures. Ha (7b)

Pore-free Welding of Brass (Porenfreies Schweissen von Messing) Leemann. *Autogene Metallbearbeitung,* Vol. 29, Feb. 1, 1936, pages 37-39. The difficulties of obtaining a satisfactory weld in brass due to the large melting range (850°-950° C.) is explained. To obtain a pore-free welded joint a burner should be used as would be taken for the same thickness in Fe; the metal is first preheated with a neutral flame to a dark red, then the flame is adjusted to excess of O by reducing the acetylene supply, and quickly welded. Without sufficient preheat, pores and poor joints result. The same conditions prevail for bronze and red brass. To make the weld invisible (of same color as the base material) a welding rod of the latter should be used. Ha (7b)

Wire Mesh and Sheets Welded Without Fusion. A. Longoria & F. L. Spangler. *Welding Engineer,* Vol. 21, Mar. 1936, pages 26-28. A "new" process is said to "cause the molecules along the welded seam of two metallic sheets, closely butted together, to intermingle, provided the edges of the plate along the seam are first heated to a certain temperature." No further explanation is given, except that the author "eliminates the joint and makes both sheets as one piece by a shock."
Ha (7b)

The Micro Testing Machine Chevenard. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 11-13. Translation by Mathew Scioletich of article in *Soudeur Coupeur,* Vol. 10, Nov. 1935, pages 9-11. Diagrams of machine and various details are reproduced from the original, and mechanical properties curves are given progressively from parent metal through the weld. WB (7b)

Autogenous Cutting of Cast Iron (Das autogene Schneiden von Gusseisen) *Autogen-Schweisser,* Vol. 8, Aug. 1935, pages 91-92. Describes a new torch developed by the Office Central de l'Acétylène et de la Soudure Autogène in Paris for cutting cast Fe. The peculiar features of the torch and its manipulation are fully considered.
WH (7b)

Welding in British Railways (Mechanical Engineering) W. A. Stanier. *Welder,* Vol. 8, Dec. 1935, pages 778-782. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 129L/8.
Ha (7b)

Use the Emery Wheel Test for Your Unlabeled Welding Rods. J. B. Ames. *Welding Engineer,* Vol. 21, Mar. 1936, pages 30-31. It is explained how a spark test will reveal the nature of the steel and how to determine the suitability of a certain rod for a given work.
Ha (7b)

Maintenance Welding in Railroad Works. Frank A. Longo. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 20-25. Extensive discussion of practical problems involved in the maintenance repair of locomotive parts by flame and arc welding on the Southern Pacific. Building up wheel centers, brazing of Monel to brass valve seats for high strength, tough seat resistant to corrosion; arc bronze welding, hard surfacing, metal spraying, scrapping of equipment by flame cutting are reviewed.
WB (7b)

The Electric Arc Welding Process. T. A. Long. *Welder,* Vol. 8, Jan. 1936, pages 803-805, 818. Advantages of welded structures over riveted, bolted or cast structures are discussed, and the advantages of electric arc welding over gas or oxyacetylene welding explained. The overall working costs of the former process are said to be lower, the speed of welding higher and distortion effects not so evident as in gas welding. The electric arc process permits controlling with proper flux covered electrodes, the metallurgical analysis of the weld deposit. Characteristics of d-c. and a-c. welding are described and the structural differences illustrated by photographs of etchings.
Ha (7b)

Progress in Welding and Cutting in 1935. R. E. Miller. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 496-497, 500-503, 506-507; Jan. 9, 1936, pages 24-29.. Considerable progress, both technical and commercial, has been accomplished the past year. Some of the developments discussed are: Oxy-acetylene cutting and welding; wider use of a.c. arc welding process; new electrodes and welding rods; electric resistance welding; and electric furnace brazing. VSP (7b)

Nitrogen in Metallic Arc Weld Metal. John W. Miller. *Welding Journal,* N. Y., Vol. 15, Feb. 1936, pages 5-10. Weld metal with 0.127% N was investigated with X-ray diffraction methods to determine composition and structure of nitride needles and are concluded to be probably made up of γ' phase of the Fe-N system and correspond to the compound Fe_4N. WB (7b)

The Welding of Wrought Iron. J. E. Fletcher. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 621-628. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 68R/4.
(7b)

Allocation of Electrodes to Various Types of Work. Jules Muller. *Welding Engineer,* Vol. 21, Jan. 1936, pages 30-32. Types of electrodes used, their comparative application and characteristics are described generally. Ha (7b)

ABC's of Welding Design. F. L. Plummer. *Industry & Welding,* Vol. 8, Jan. 1936, pages 20-22. The basic factors in designing good welds are discussed.
Ha (7b)

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Inspection of Welded Seams in Pressure Vessels. Wm. D. Halsey. *Welding Journal,* N. Y., Vol. 15, Jan. 1936, pages 20-23. The difficulties involved in inspection of welded pressure vessels constructed in weld-pioneering era, prior to perfection of present welding are discussed and a new method of inspection is proposed. The method consists of cutting out circular disks which include the "antique" weld and a portion of the parent metal. The device for performing the operation is a circular milling cutter which has been improved since its appearance in Germany and Great Britain for weld inspection purposes. The improvement consists of an extended section on the cutter which allows retention of the disk cut out. This is important for pressure vessels because of impossibility of recovery of the disk if not retained. The disk is deep etched after cutting out and shows the macro of the weld thus allowing lack of fusion, dirtiness, etc., to be determined. It is proposed that where the weld macro passes inspection the hole formed in cutting the disk be tapped and provided with a plug. It is suggested that present qualification tests have gone too far in one direction (tensile strength and ductility tests) and not far enough in other directions such as requirement of welder test on actual material he will fabricate, whether plate, pipe, etc., and the X-ray examination of finish welded pieces constantly so as to give a continuous history of the soundness of the product the welder produces. It is argued that the present requalification tests at intervals of 6 months do not check on the welder except when he is on his best behavior. For unfired pressure vessels it is suggested that inspection of the weld with the cut-out-coupon method above would be more positive and less expensive than periodic requalification tests. The test holes may be closed by welding and it is suggested that the seam could be made intact thereby. WB (7b)

Welding in Aviation. Carl De Ganahl. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 8-9. The use of 1% Cr, ¼% Mo steel tubing is considered ideal for aircraft because of easy weldability and is reliable with proper welding technique. Heat treating of Cr Mo steel weld is standard procedure for safety. Oxyacetylene flame is used almost exclusively in aircraft due to extra care and training required for arc welding of thin sections. Spot welding abandoned because of the lack of toughness at the welds due to high rate of quenching of the Cr Mo steel and due to breakage of spot welds during heat treatment subsequent to welding. Corrosion of Cr Mo tubes is serious consideration and Cd coating is used for external protection, internally a film of boiled linseed oil is used by pouring the oil in through small hole at one end and draining, after which the holes are closed with metal screw. Aviation industry is now looking toward hard rolled, high tensile 18-8 steels for high strength (150,000 yield point) and good ductility (15-25%). The material is successfully spot and shot welded. The Cb or Ti stabilized 18-8 is standard for exhaust manifolds in Navy and Army Corps equipment. Weight strength ratio frequently favors use of 18-8 over other metals for the larger parts and higher stresses. WB (7b)

The Strengthening of Weak Bridges. C. S. Chettoe. *Structural Engineer,* Vol. 14, Feb. 1936, pages 62-84. The most satisfactory method of strengthening wrought Fe or steel girder bridges is by welding the weak, previously riveted flange angles and new supporting plates to structure. Cast Fe arches are best strengthened by encasement in reinforced concrete. FPP (7b)

Recent Progress in Realm of Aluminum and Aluminum Alloy Welding (Aperçu sur les récents progrès réalises dans le domaine de la soudure de l'aluminium et de ses alliages) Jacques Douchement. *Revue de Métallurgie,* Vol. 33, Mar. 1936, pages 189-196. Factors specifying welding conditions for light alloys are enumerated and the means for meeting them are presented. In fusion welding flux, filling rods and base metals must be considered. In resistance welding time and current concentration are important. JDG (7b)

Welding and Gas Cutting Industries in the United States of America (Aperçus sur l'Industrie de la Soudure et de l'Oxy-Coupage aux Etats-Unis) L. de Jessey. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Nov.-Dec. 1935, pages 1990-2005. Describes applications. FR (7b)

The Correct Repair of Gray Castings by Gas Fusion Welding with Cast Iron (Die richtige Ausbesserung von Grauguss durch Gasschmelzschweissen mit Gusseisen) H. Reininger. *Giesserei,* Vol. 23, Jan. 31, 1936, pages 52-57. The practical points to be observed in fusion welding of cast Fe are reviewed; this method can be used to make fully satisfactory repairs of any kind of defect in the casting provided proper pre-heating, welding temperatures and fluxes are observed. Suitable materials and procedures are described. 31 references. Ha (7b)

Welds Re-lace Rivets on Barges in Pittsburgh District. E. H. Sykes. *Welding Engineer,* Vol. 21, Mar. 1936, page 23. Advantages are briefly discussed. Ha (7b)

Electric Arc Welding of Stainless Steel. Geo. H. Sandberg. *Industry & Welding,* Vol. 8, Feb. 1936, pages 50-51, 64. Procedures used for different kinds of stainless steel are described. Ha (7b)

Welding, Soldering and Flame-cutting of Gray Iron (Schweissen, Löten und Brennschneiden von Grauguss) C. Stieler. *Giesserei,* Vol. 23, Mar. 13, 1936, pages 129-134. The different methods of welding of castings for repair purposes in the foundry are discussed and illustrated by examples. Flame-cutting can be done with the oxy-acetylene flame or electric arc by using special torches with heating nozzles. The metallurgical changes in the material near welds and cuts are explained. Ha (7b)

Welding of Inconel (La Soudure de l'Inconel) A. Boutté. *Revue de la Soudure Autogène,* Vol. 26, Jan. 1936, pages 8-9. Composition of Inconel is as follows: 80 Ni, 14 Cr and 6 Fe. (1) Oxy-acetylene welding: Owing to its high Cr content this alloy is to be classified, as to welding purpose, with stainless steels. Difficulties met with are the same as with the latter. Inconel can be welded using a special flux which is not to dissolve Cr oxide film but is to prevent formation of this film by giving a protective coating impervious to O_2 of atmosphere. Torch capacity must be between 50 and 75 liters of C_2H_2/hr. Strength of welds and corrosion resistance are about the same as that of base metal. (2) Arc welding: electrodes must be of Inconel coated with a special flux which allows maintaining a short arc. D.c. with reverse polarity is used. FR (7b)

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Welded Steel Bridges in Victoria, Australia. W. T. B. McCormack. *Welder,* Vol. 7, Oct. 1935, pages 723-729. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 130L/10. Ha (7b)

Cutting Structural Steel. J. H. Zimmerman. *Welding Journal,* N. Y., Vol. 15, Feb. 1936, pages 21-25. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 129L/1. WB (7b)

Saw Welding. E. E. Olson. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 17-19. Attention is called to the highly specialized art of flame welding applied to repair of saws due to expert knowledge required of the effects of welding heat. Overheating of the high strength heat treated and worked metal of the saw is minimized by welding a small section and immediately forging the welded section gives fine grain. Backhand welding is recommended and other special considerations are reviewed. Welding of steel conveyor belting is best carried out by same procedure used for saw repairs. Bronze welding of saw teeth recess for building up of work material is reviewed. WB (7b)

Use of Welding Technique in Artcraft (Anwendung der Schweisstechnik in der Kunst- und Bauschlosserei) M. Roeder. *Autogene Metallbearbeitung,* Vol. 29, Mar. 1, 1936, pages 72-73. Examples of artistic effects in welding railings, gates, fences, etc. are described. Ha (7b)

The Welding of Aluminum. G. O. Hoglund. *Welding Engineer,* Vol. 21, Feb. 1936, pages 26-30. Review of processes applied in Al welding with examples; mechanical properties of wrought Al alloys are given. Ha (7b)

Welding in Railway Repair and Construction (Les Applications de la Soudure dans les Ateliers d'une Compagnie de Chemin de Fer) A. Heydacker. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Nov.-Dec. 1935, pages 1960-1978. Lecture before the French Welders' Society. Applications described deal chiefly with repair work. Following parts are studied: wheels, steel cross stay castings for locomotives, cast Fe cylinders, boilers. Possibility of using various welding processes for each part is discussed and illustrated. Last section describes all-welded tender. FR (7b)

Welding Alloy Steels in Aviation. C. de Ganahl. *Industry & Welding,* Vol. 8, Feb. 1936, pages 56-58. The particular problems in plane manufacture are discussed. Ha (7b)

Air-Powered Scoop, Arc-Welded, Digs, Carries and Dumps by Own Power. A. F. Davis. *Iron Age,* Vol. 137, Mar. 5, 1936, pages 36-38. Describes an air powered scoop which features arc welded seamless tubular construction. It was developed by Midwest Piping and Supply Co., Inc. Arc welding provides definite economies of construction in addition to greatest possible strength. VSP (7b)

Construction and Maintenance Problems Solved by Welding. A. F. Davis. *Welding Journal,* N. Y., Vol. 15, Jan. 1936, pages 2-5. A review in text and pictures of a variety of specific welding applications. WB (7b)

Arc Welding Used in Dredge Reconstruction. A. G. Bissell. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, page 10. Descriptive plus photos. WB (7b)

Welding in the Fabrication of Large Reflecting Telescopes. A. E. Gibson *Iron Age,* Vol. 137, Feb. 6, 1936, pages 20-23. Deals with the construction of metal parts of a telescope, particularly those fabricated by welding. The work was done by Wellman Engineering Co. on a telescope for the University of Texas. High strength, rigidity and low weight are claimed for this form of fabrication. VSP (7b)

Welded Pressure Vessels (Récipient à Pression Soudés) H. Gerbeaux. *Revue de la Soudure Autogène,* Vol. 27, Dec. 1935, pages 9-10. It is necessary to reinforce a small radius pressure vessel around a cut circular opening. FR (7b)

Some Thoughts on the Development and Promotion of Arc Welding. LaMotte Grover. *Welding Engineer,* Vol. 21, Feb. 1936, pages 23-24. Wrong and right principles in present day welding practice are discussed; better and more rapid progress is foreseen when certain practices which are merely a tradition are abandoned for more scientifically and practically proven facts. Ha (7b)

Composition of Electrode Coatings. C. J. Holslag. *Welding Journal,* N. Y. Vol. 15, Feb. 1936, page 12. Brief, concise review of basic requirements of welding rod coatings and some of the many compounds used to effect desired arc and weld deposit character. WB (7b)

Oxy-Acetylene Welding and Cutting Progress. *Machinery,* N. Y. Vol. 42, Feb. 1936, pages 400-401. Present status. Ha (7b)

The Welding of the Alloy Steels. J. C. Hodge. *Welding Journal,* N. Y., Vol. 15, Jan. 1936, pages 6-14; *Iron Age,* Vol. 137, Jan. 30, 1936, pages 20-23, 81; Feb. 13, 1936, pages 52-56; *Canadian Machinery,* Vol. 47, Jan. 1936, pages 43-47. Discussion of the factors involved in the production of hard, martensitic transition zones next to the weld bead and the necessity for control or elimination of extreme hardness, and low toughness by means of preheat and after anneal or stress relief. General discussion of the suitability of various types of low alloy steels for particular applications where low alloy required less plate thickness and thinner plate allowed rapid construction by welding. WB + VSP (7b)

Electric Arc Welding and Its Applications. VII and VIII. M. Maurice Lebrun. *Welding Journal,* British, Vol. 32, Dec. 1935, pages 358-361; Vol. 33, Jan. 1936, pages 6-10. Brief discussion of d.c. arc welding generators, protective masks, glasses, welding and ground cables and electrode holders. Shows methods of suppressing overloads, connection of 2 welding units in series with one generator, and log of test of 3 phase transformer in a.c. welding. WB (7b)

Design and Construction of an All-Welded Multiple-Story Steel Structure. R. W. MacBride. *Structural Engineer,* Vol. 13, Dec. 1935, pages 458-466; discussion, Vol. 14, Feb. 1936, pages 99-101. Describes the design, assembly and erection of an all-welded steel-frame turbo blower power station, and stresses simplification of operations with welded construction as compared to riveted. Cost and weight of welded structure are less than riveted. Recommends selection and careful training of own welders, who become proficient in short time. FPP (7b)

Autogenous Welding of Copper (La Soudure autogène du Cuivre). L. Matteoli. *Cuivre et Laiton,* Vol. 9, Feb. 29, 1936, pages 79-81. The Cu deposited in the weld is extremely brittle, the tensile strength near the weld is not more than 15-16 kg./mm.^{2}, and the metal has the structure of cast Cu. The heat treatment to which the weld must be subjected to restore the good mechanical properties of Cu consists in heating and hammering, or, if the material is only very thin, hammering in cold state; hammering should be followed by annealing at 500°-600° C. Tensile strength is then 22-23 kg./mm.^{2} Steel and Cu can be welded together in the same manner as Cu to Cu, with a Cu welding rod. Arc welding does not give very satisfactory welds. Weld brazing of Cu is best done with a brass weld rod of 54-58% Cu, remainder Zn; the melting temperature of this composition is 880° C. Soldering with Ag and Sn is discussed, and also joining by hammering alone under heat is described although this method is not frequently employed. Ha (7b)

Hydraulic Manipulator of Welded Rolled Steel. J. D. Knox. *Steel,* Vol. 98, Mar. 9, 1936, pages 58, 61; *Blast Furnace & Steel Plant,* Vol. 24, Mar. 1936, pages 254-255. Blooming-mill manipulator is built of rolled plates and slabs of Cu-bearing 0.16-0.22% C steel. Thickness varied from 1½″ to 4″. Slabs up to 12″ thick were used where greater thickness was required. Base is heavier but movable parts are lighter than those of most manipulators. All plates were flame cut by machine to desired shape and contour. Various sections were joined by arc welding, 42,000 lb. of coated electrodes being used. Complete manipulator involved 1975 welded pieces. Every weld was peened and each complete part was stress relieved by holding it at 1100° F. for 4-5 hr. Questionable welds were drilled for inspection. All connecting-rods and links are of forged or welded steel. Pins and their bushings were case-hardened. About 40,000 lb. of bronze was used for bearings and at other points of friction. MS (7b)

Welding at the Ford River Rouge Plant. *Mill & Factory,* Vol. 18, Jan. 1936, pages 186-201. Practically all permanent stationary connections in the Ford cars and trucks are welded. The company's own oxygen plant supplies hundreds of welding machines performing over 5000 welding operations in the factory. The pressed steel division operates 600 completely automatic welding machines, including spot, arc, seam, flash, oxy-acetylene, etc. Gas tanks are now held in place by a traveling "Iron Man" while seams are being welded. All seam-welding operations are equipped with "thyratron" control; speed is 102″ in 1½ minutes, with 11 spots to the inch. A synchromatic timer controls the inner door-panel welding, which is performed, like a multiple-type punch press, with 40 spots simultaneously. The 3 panels of the rear body assembly are simultaneously welded, in a single "balloon" flash welding machine, along two 72″ seams in 7 seconds. 12 double-head, fully automatic arc welding machines weld the rear radius rod brackets to the tube, both sides at once, at a speed of 55″ a minute and current of 300 amperes, without a single skip. Oxy-acetylene welding is applied in many miscellaneous operations, especially at comparatively inaccessible points on the body. FPP (7b)

Permanency of Oxy-Acetylene Welding. F. C. Hutchinson. Presented at 36th Annual Convention, *International Acetylene Association,* Nov. 12-15, 1935, 9 pages. Available in mimeographed form from the offices of the Association, 30 East 42nd Street, New York, N. Y. Oxyacetylene pipe welds, made strong and tight by procedure control, remain so throughout the life of the pipe. Service and laboratory tests to determine corrosion resistance of oxyacetylene pipe welds have demonstrated that the welds can be counted on as at least equal to the pipe itself, regardless of whether corrosive attack comes from the inside or outside. Ability of oxyacetylene pipe welds to withstand terrific punishment without failure illustrated by severe treatment in construction of overland pipe lines, and by extraordinary tests imposed by hurricane, flood and earthquake. EVD (7b)

Little Known Facts Concerning the Repair of Bells. M. Ralph Horne. *Aluminium & the Non-Ferrous Review,* Vol. 1, Nov. 1935, pages 79-80. Refers just to the fact that bells which have cracked can be repaired by welding, taking care that the weld metal has the same composition as the bell. Instances of church bells so repaired are illustrated. JCC (7b)

The Welding of Low Alloy Steels. J. C. Holmberg. *Welding Journal,* British, Vol. 32, Oct. 1935, pages 306, 308; *Sheet Metal Industries,* Vol. 9, Nov. 1935, pages 715-716. From a paper before the American Welding Society. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 68R/9. WB + AWM (7b)

Composition of the Added Metal in Electric Arc Welds (Composizione del metallo di apporto nella saldatura elettrica ad arco) III. L. Losana & M. Jarach. *La Metallurgia Italiana,* Vol. 27, Oct. 1935, pages 703-706. The division of W, Mo, and V between slag and the added metal has been determined. The Fe-W alloy contained 74.86% W; the Fe-V alloy contained 52.46% V; the Fe-Mo alloy 48.70% Mo. In addition, there was some Mn, Si and C in each. W readily migrates from the electrode coatings to the weld, especially in the presence of Mn. Mo is little influenced by Mn, but C content increases with Mo content. V migrates readily with Mn present, while C increases greatly in the presence of V. AWC (7b)

Advantageous Use of Gas Fusion Welding in Machine and Boiler Design (Vorteilhafte Anwendung der Gasschmelzschweissung im Maschinen- und Kesselbau) K. Kohrs. *Autogene Metallbearbeitung,* Vol. 29, Jan. 1, 1936, pages 1-10. Examples illustrate the great savings which can be realized in cost of repairs when fusion welding is applied without reducing the mechanical properties of the welded parts. Ha (7b)

Casting and Welding (Giessen und Schweissen) Gustav Meyersberg. *Montanistische Rundschau,* Vol. 28, Jan. 16, 1936, pages 6-7. A general discussion of common practice in casting and welding metals and alloys. BHS (7b)

Autogenous Welding of Copper (La Soudure Autogene du Cuivre) L. Matteoli. *Cuivre et Laiton,* Vol. 9, Jan. 30, 1936, pages 31-35. Differences between autogenous welding of Fe and Cu because of their metallurgical and physical properties, preparation of the pieces, welding rods and welding procedure are discussed in general. Ha (7b)

Forge Welding with Water Gas. J. B. Nealy. *Heat Treating & Forging,* Vol. 22, Feb. 1936, pages 89-91. **Mechanized Forge Welding of Tanks.** *Steel,* Vol. 98, Feb. 10, 1936, pages 30-33. Describes equipment and practice of Columbiana Boiler Co., Columbiana, O. Natural-gas is used for welding. For certain products, this gas is converted to blue water-gas by proportioning with steam. Hammer welding machines are used in making longitudinal and circumferential seams of pressure vessels, except head seams which are made on roll and hammer welders. Hammer welder consists of a long steel mandrel on which anvil or bucker-up and lower forge ride back and forth. Below is a track on which rides carriage carrying vessel to be welded. Shell section is placed on carriage and run into welding position, and forges are placed on seam to be welded, one above and outside and other below and inside shell. Forges consist of steel cases filled with refractory brick with opening of approximately 5″ by 10″, into which gas burner fires. After sufficient length of time, forges are moved away and at same time, anvil and hammer slide and swing into position respectively and lap is welded. Only about 12″ of seam are heated and welded at a time and process is repeated until seam is completed. Sections then are welded together. Roller welder has an overhead steel platform with rails and carriage from which pneumatic hammer and hold-down devices are suspended. Just below is a steel roll and mandrel over which shell section rides and which serves as an anvil. Forges on long steel supports are just far enough below mandrel to straddle lower portion of shell wall. Rollers on arms inside section hold shell in position while it is rotated and welded. As each section is welded, it is annealed in a gas-fired pit-type furnace at 1650° F. After all circular seams are welded, vessel is annealed in a gas-fired ring-type furnace. MS (7b)

A Note on Some Results Concerning the Variation of Chemical Composition in the Gas-welding of Ordinary Steels. Albert M. Portevin & A. Leroy. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 475-481. Reports analyses of gas welds of a number of C steels. See also *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 66R/1. JLG (7b)

Welding for the Steel Foundry Industry. V. G. Pearson. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 629-634. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 66L/2. (7b)

Welding in the Shipbuilding Industry. W. Strelow. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 385-390. General review with reference to German practice. See also *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 66R/10. JLG (7b)

Gas Welding Applied to Reconditioning of Bronze (Die autogene Auftragschweissung von Bronze) Benno Sixt. *Autogen-Schweisser,* Vol. 8, Oct. 1935, pages 109-113. 10 typical welding jobs on cast bronze objects are discussed and illustrated stressing the peculiarities and precautions to be borne in mind when welding bronze. WH (7b)

Repair of Charring Tanks for Charring Wood (Instandsetzung von Glühkesseln für Holzverkohlung) F. Stiehl. *Autogene Metallbearbeitung.* Vol. 29, Mar. 1, 1936, pages 75-76. Cracks in tanks of 1500-1800 mm. diam. and 3-4 m. length, 12 mm. thick were repaired; 100 mm. lengths at a time were welded and then hammered. The tanks must stand continuous heating to 800° C. and cooling, and the repaired cracks held well in service. Ha (7b) 1

Autogenous Welding for Assembling a Railing (Autogenschweissung bei Herstellung eines Treppengeländers) F. Stiehl. *Autogene Metallbearbeitung,* Vol. 29, Mar. 1, 1936, pages 74-75. Describes process. Ha (7b)

Welding in Marine Engineering. E. F. Spanner. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 591-597. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 128L/9. (7b) 2

The X-ray Examination of Welds. R. A. Stephen. *Sheet Metal Industries,* Vol. 9, Oct. 1935, pages 646-647. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 129L/8. AWM (7b)

Light Weight Rigid Welded Base on Kingsbury Drilling Machine. G. Donald Spackman. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 19-20. Details of base assembly by welding of plates which is estimated to have saved 33% of the weight of castings with the same strength. WB (7b)

3 **High Manganese Steel Welding.** E. W. P. Smith. *Industry & Welding,* Vol. 8, Feb. 1936, pages 59-62; Mar. 1936, pages 52-54. The particular uses of hard tough Mn steels are reviewed and means recommended for welding processes in resurfacing, repairing cracks, grinding. Ha (7b)

Difficult Repairs of Thick-walled Pieces (Schwierige Instandsetzungen an dickwandigen Werkstücken) J. Sehring. *Autogene Metallbearbeitung,* Vol. 29, Mar. 1, 1936, pages 65-68. A number of examples show how one should proceed when welding or repairing by welding thick pieces. Correct heating, no cold nor overheated spots, correct adjustment of the flame, and above all, conscientious welders are of first importance in carrying out difficult welding problems. Ha (7b) 4

Welded Pipe Structures for Fences (Geschweisste Rohrkonstruktionen als Einfriedigung) E. Schuch. *Autogene Metallbearbeitung,* Vol. 29, Mar. 1, 1936, pages 73-74. Descriptive. Ha (7b)

Residual Stresses, Distortion and Welding Procedure. H. W. Townsend & J. L. Adam. *Welding Journal,* British, Vol. 33, Jan. 1936, pages 16-17. Review of papers before Welding Symposium, Iron and Steel Institute 1935. WB (7b) 5

Physical-Chemical Phenomena of the Transfer of Metal During Welding. G. M. Tichodeev. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 26-31. 3 stages in arc welding process are considered; drop formation, expulsion of the drop to the work and solidification. 3 sources of heat for the first stage are kinetic energy of ions in cathode space, incandescent gases in cathode space and exothermic reactions in the fluid drop. Experiments were conducted with welding wire of varying C content keeping Mn and Si constant and other wires varying either Mn or Si while keeping the others constant. WB (7b) 6

The Phenomenon of the Erratic (Unstable) Welding Arc. G. M. Tichodeev. *Welding Journal,* N. Y., Vol. 15, Feb. 1936, pages 13-17. Cathode ray oscillographs of voltage and current of welding arc are shown for several compositions of welding rod. The stable arc is obtained when Si, SiO_2, Al, Al_2O_3 in the rod do not exceed limits given in the text. Stabilizing materials for arc are considered to be Fe oxides, CaO, MnO, FeS either in the rod or coating. Deoxidation with Al is considered to produce welding wire with poor welding quality due to erratic arc. WB (7b)

7 **Condenser Welding of Heating Resistors.** J. Wrana. *Electrical Review,* Vol. 117, Dec. 20, 1935, page 852. From *Elektrotechnische Zeitschrift,* Sept. 5, 1935. See "Welding of Wires of Nickel-chromium and High Heat Resisting Alloys by Condenser Discharge," *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 127R/5. MS (7b)

Electric Arc Repair of Rails. A. M. Wood. *Industry & Welding,* Vol. 8, Feb. 1936, pages 26-30. Procedure of building up worn rail ends and equipment is described. Ha (7b)

8 **Tests to Determine the Feasibility of Welding the Steel Frames of Buildings for Complete Continuity.** W. M. Wilson. *Welding Journal,* N. Y., Vol. 15, Jan. 1936, pages 28-38. Mechanical-civil engineering considerations. WB (7b)

The Various Types of Electric Butt-welding Machines (Die verschiedenen Arten elektrischer Stumpfschweissmaschinen) H. Wilbert. *Siemens-Zeitschrift,* Vol. 16, Feb. 1936, pages 41-46. Manually operated, semi-automatic and full-automatic machines are described and the selection of a proper type discussed as depending on section to be welded, kind of material, shape of workpiece and seam. Ha (7b) 9

Welding on Display at the Chemical Show. Orn T. Weirs. *Welding Engineer,* Vol. 21, Feb. 1936, pages 32-36; Mar. 1936, pages 34-38. Advantages of welded structures over other constructions are discussed and many examples of the oil, chemical, food and other industries illustrated. Ha (7b)

Welding of Vokar. N. M. Zarubin. *Redkie Metallui,* Vol. 4, Sept.-Oct. 1935, pages 48-51. In Russian. "Vokar," a mixture of W and C, was welded on to bar iron containing 0.05% C. The weld was examined micrographically and found to contain only WC and a solid solution of WC in Fe. No W_2C was found. HWR (7b) 10

British Railway Welding Practice as Applied to Bridge and Structural Repair Work. II. H. G. Ellson & J. Miller. *Welder,* Vol. 8, Jan. 1936, pages 819-823. Methods of repairing and reinforcing are described and illustrated by examples. Ha (7b)

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The Metallurgy of "Pure" Iron Welds. Gilbert E. Doan & William C Schulte. *Metals Technology,* Feb. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 694, 16 pages. Welds were made with carbonyl Fe, H-purified carbonyl Fe, and steel in purified A and in air. In the purified A a crater did not form and no penetration resulted. Substantial removal of solid elements takes place on welding in A as well as on welding in air. Oxidation therefore does not seem entirely responsible for this removal in ordinary welding. The gas content of both Fe and steel was high in welds made in air. A coating was only partly effective in excluding these gases. Fe welds made in A are sound provided the A is of high purity, but a very little O in the A or steel causes porosity. Porosity in steel welds made in A is attributed to evolution of CO. Coated Fe welds made in air showed normal penetration and porosity was present. Fe welds in A have a coarse grain, while the same welds made in air were fine grained. Grain size seemed to correlate with N and O content. Microstructures are as would be expected from composition. Fe welds made in A were of low strength and plastic, elongation being 90% in tensile test. Fe welds made in air had a high strength with low ductility. Welds with coated rods had intermediate properties. Air has less effect on properties of steel welds than it does on Fe welds. Fe welds made in A do not age harden, but welds made in air do. JLG (7b)

The Manufacture of Welding Electrodes. C. H. Davis. *Mechanical World & Engineering Record,* Vol. 98, Nov. 15, 1935, pages 472-474. Paper presented to the Institution of Chemical Engineers. Coils of wire are cleaned, straightened and cut. Contact projections are then stamped on the wire and the coating extruded over it. WH (7b)

Resistance Welding. I. Theory and Application. L. H. Frost. *Welding Engineer,* Vol. 21, Jan. 1936, pages 44-47. Brief discussion of principles of the various welding processes and equipment used. Ha (7b)

Cast Welding Fittings for Pipe Lines (Gegossene Schweissfittings für den Rohrleitungsbau) Ernst Greger. *Der Autogen-Schweisser,* Vol. 8, Sept. 1935, pages 100-104. Advantages, commercial designs, joining and testing of pipe fittings joined by gas welding are discussed at length. The old-type screwed fittings are critically compared with the novel welded cast fittings. WH (7b)

A. C. Production Arc Welding. I. O. A. Tilton & J. T. Phillips. *Industry & Welding,* Vol. 8, Jan. 1936, pages 15-18, 30. The advantages of a.c. for welding with coated electrodes are due to the improved quality of the weld and the practical absence of the magnetic blow. Operating conditions are explained and welding transformer operating data given in curves. Ha (7b)

Underframes of 70-Ton Gondola Cars Welded Without Altering Basic Design. John E. Tesseyman. *Steel,* Vol. 98, Feb. 24, 1936, pages 60-61. Fabrication of underframe by arc welding instead of by riveting provides greater rigidity of structure and reduction in weight. Parts are assembled on a surface bed which serves also as a jig to hold them in place while they are tack welded. For finish welding, assembly is suspended by trunions and is turned, as required, to facilitate welding operations. MS (7b)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Reviewing Some Current Methods for Treatment of Metal Surfaces. *Steel,* Vol. 98, Mar. 2, 1936, pages 54, 57. Describes briefly (a) electrolytic cleaning of ferrous metals in solutions of Na_3PO_4 or Na_2CO_3; (b) electrolytic scale removal in acid and alkaline baths with simultaneous deposition of Pb or Sn; (c) electrolytic cleaning and pickling by making article first, the cathode in a 2-20% H_2SO_4 bath, and then the anode in a 25-75% H_2SO_4 bath; (d) forming a corrosion-resistant surface by electrolysis in a $Zn_3(PO_4)_2$ bath; and (e) forming a surface even more corrosion resistant by immersing Zn or Cd plated parts in a $Zn_3(PO_4)_2$ solution. MS (8)

Metal Finishing Advances in 1935. HERBERT R. SIMONDS. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 553-554, 556-560; Jan. 9, 1936, pages 44-47. Discusses the practical applications of laboratory developments during the past year. They are: Al coating of steel, bright Ni plating, chemical black coating; plating on plastics; and improved enamels and lacquers. Includes comments from many authorities in various branches of metal finishing industry. VSP (8)

The Structure of Metallic Coatings, Films, and Surfaces. Introductory Paper and Concluding Remarks. CECIL H. DESCH. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1045-1048, 1288-1290. The importance of the symposium held by the Faraday Society on the structure of metallic coatings, films and surfaces is stressed and a summary of the papers presented is given. PRK (8)

■ 8a. Pickling ■

Conveyors Applied to Strip Mill Pickling Operations. J. H. HOUGH. *Iron Age,* Vol. 137, Feb. 20, 1936, pages 34-36. Describes method of continuous pickling and equipment used. VSP (8a)

Inhibitors. KENNETH B. LEWIS. *Wire & Wire Products,* Vol. 11, Mar. 1936, pages 127-129, 155. The action and types of inhibitors in wire drawing are discussed together with experimental study of the qualities of an inhibitor. It was found that an inhibitor acts differently on the various metallographic constituents of a steel; two general classes can be distinguished: low C basic steel rod and spheroidized steel, and patented rod, high C strip and medium C rod as rolled. An inhibitor satisfactory for one class is, in general, not satisfactory for the other, a mixture of both proved entirely unsatisfactory. Ha (8a)

Descaling of Metals. C. G. FINK & T. H. WILBER. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Oct. 12, 1934, pages 255-256. See "The Bullard-Dunn Electrochemical Metal Descaling Process," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 404L/8. MS (8a)

■ 8b. Cleaning including Sand Blasting ■

Stripping Costs on Damaged Parts Reduced by Electrolytic Process. *Steel,* Vol. 98, Mar. 23, 1936, page 49. Lacquer and enamel coatings can be stripped satisfactorily from metal articles by an electrolytic process. Parts are in an alkaline bath for 5 min., the parts being negative for 10 sec., then positive for 10 sec. and alternately negative and positive for entire period. In some cases, different periods for anodic and cathodic treatments may be required. Bath contains 13.6 oz. NaOH, 6.38 oz. Na_3PO_4, and 1.62 oz. Na_2SiO_3 per gal. H_2O. Equipment required consists of a d.c. generator of 6-12 volts, a steel tank, and where required, a conveyor. Between 30 to 50 amps./ft.^{2} may be used. Temperature of bath should be 200°-205° F. Operation is followed by a H_2O rinse. Method gives excellent results as to cleanliness. MS (8b)

■ 8c. Polishing & Grinding ■

Finishing Aluminum with Abrasives. H. K. WORK. *Abrasive Industry,* Vol. 17, Feb. 1936, pages 8-11, 23. Differences in polishing technique for Al from that for other metals are discussed. Wheels are softer and finer abrasive used. Procedure is briefly sketched and typical polishing operations for various Al products detailed. When castings which have been repaired by welding are finally to be given Alumilite finish, the welded areas are blended by polishing after annealing. Production of high luster and coloring of Al product are discussed. WB (8c)

Surface Grinding of Hardened Steels. W. DE V. HUNT. *Heat Treating & Forging,* Vol. 22, Feb. 1936, pages 79-83; Mar. 1936, pages 133-138. Paper read before the Steel Treatment Society of Australia. Summarizes history of grinding and grinding wheels and describes briefly manufacture of artificial abrasives; and selection of grinding-wheels. Recommendations for abrasives and vehicles for lapping various materials are given together with tests to obtain information about grinding and hardening cracks. MS (8c)

Low Cost Polishing. FRED B. JACOBS. *Mill & Factory,* Vol. 18, Mar. 1936, pages 62-64, 128-131. By using polishing methods for exposed metal parts of electric vacuum cleaners as examples, the author emphasizes attention which must be paid to setting-up wheels with glue and abrasive, type of glue, size of grit, drying time, wheel balance, etc. Automatic polishing is not convenient with the parts in question. Al alloy parts are polished dry with No. 120 Turkish emery on canvas wheels, oiled on felt or sheepskin wheels, cut down with tripoli, cleaned in organic solution, and color-buffed on previously worn-down wheels, without subsequent plating. Steel tubing is polished with a "skate" before being electroplated with Ni and Cr. FPP (8c)

Roll Grinding. J. R. LEONARD. *Wire & Wire Products,* Vol. 11, Mar. 1936, pages 125-126, 149-152. The problems occurring in the manufacture of highly polished rolls for wire and sheet rolling are discussed, the grinding process, coolants and lubricants, and grinding machines described. Ha (8c)

Grinding and Polishing of Iron and Metals (Das Schliefen und Polieren von Eisen und Metallen) KOCH. *Oberflächentechnik,* Vol. 13, Mar. 17, 1936, pages 63-64. Grinding, honing and polishing processes and machinery for these operations, speeds applied, and treatment of plated pieces are reviewed. Ha (8c)

Grinding Cobalt Wire to a Diameter of One-half Millimeter. O. S. MARSHALL. *Machinery,* N. Y., Vol. 42, Mar. 1936, page 466. Describes the procedure in making the wire from a 3/32″ square Co bar of 1½″ length. Ha (8c)

Abrasives and Grinding at the Ford River Rouge Plant. *Mill & Factory,* Vol. 18, Jan. 1936, pages 318-342. Grinding operations at the Ford plant are characterized by the variety of sizes, costs and types of wheels and by the dependence of the company on the technical cooperation of the abrasive manufacturers. The only accurate guides to grinding wheel quality are performance data, furnished at this plant by detailed comparative studies of wheels proposed for a specific operation. Factors considered are total number of pieces ground per wheel, hours of service, number of dressings, average production rate, average production per dressing, average approximate cost per part. Detailed description is given of grinding operations on the camshaft and the crankshaft. Extreme hardness and toughness of the cast alloy steel crankshaft necessitate 24″ to 42″ diameter grinding wheels for most semifinishing and all finishing operations. The grinding of cast alloy pistons, piston pins, valve seats and rear axles is described and the use of other miscellaneous grinding equipment is outlined. FPP (8c)

Barrel Burnishing. W. R. MEYER. *Monthly Review of the American Electroplaters' Society,* Vol. 22, Dec. 1935, pages 36-39. Extended abstract of "Das Polieren in Trommeln," F. Schwarz, *Oberflächentechnik,* Vol. 12, No. 20, 1935, pages 243-247. Barrel burnishing consists, first in an abrading action in which minute projections are worn off with some plastic flow, followed by a pressure homogenization of the surface in which the higher parts are worked into the depressions with a more or less mirror-like surface resulting. Both actions are accompanied by etching which keeps the metal free from oxide. A burnished surface consists of a severely cold-worked surface layer with a very fine crystalline structure. Such layers have greater resistance to chemical action than unburnished metal. Barrel burnishing may be done (1) dry, (2) wet, with soap solutions, (3) with steel balls, usually in the wet way, (4) scouring, with acids and an abrading agent like sand. Under (1) dry leather scrap with additions of Vienna lime, alumina, or rouge, at a barrel speed of 20-40 r.p.m. is used to burnish Ni or Cu plated articles and also Al and Zn. Under (2), wet burnishing without balls, only certain classes of work can be handled. Cavities will not be burnished. Wooden barrels at 30-50 r.p.m. are used. Some of the solutions are: for Al, acid K or Na fluoride .7, Igepon or Nekal .13, Na bisulphate .5 ozs/gal. For Fe and steel, soap flakes 5, soda ash 2.5, NaCN .7 ozs/gal. For Cu and Cu alloys, soap powder 4, soda ash 3, NaCN .13 ozs/gal. Under (3) steel balls, slugs, and jacks are used, dry or wet. If wet, same solutions as above. Condition of the steel balls is important factor. Best balls are highly polished hardened Cr steel. Barrel speeds 20-40 r.p.m. Under (4) sharp sand plus 1-5% solution of H_2SO_4. Time required may be from about 10 hrs. for brass and bronze up to 60 hrs. for materials like cast Fe. GBH (8c)

■ 8d. Electroplating ■

Chemical and Physical Properties of Electrolytically-deposited Metals in Relation to Their Structure. M. SCHLÖTTER. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1177-1181. Discussion page 1218. The chemical and physical properties of electrolytically produced metals can be changed by allowing anions to enter the crystal lattice. A relation was established between size of crystallites and overvoltage, both being dependent on the nature of the anions. A higher voltage corresponds to a larger anion. The higher overvoltage is also associated with higher concentration of H in the metal. Cu and Ag deposited from iodide solutions contain appreciable quantities of I_2 which results in an expanded lattice; the expansion increases with rise in the I_2 content. As the I_2 content in Ag deposits increases, the color changes from white to golden yellow. Ag containing intermediate quantities of I_2 does not blacken at all when treated with H_2S. In addition to the anions, the metal contains H_2. PRK (8d)

Ductility and Adhesion of Nickel Deposits. F. P. ROMANOFF. *Monthly Review, American Electroplaters' Society,* Apr. 1935, pages 8-20. See *Metals & Alloys,* Vol. 6, June 1935, page MA 238L/1. GBH (8d)

Influence of Bath Temperature on Chromium Hardness. R. J. Piersol. *Metal Cleaning & Finishing,* Vol. 7, Apr. 1935, pages 169-172. With a solution containing 250 g./l. CrO_3 and 2.5 g./l. H_2SO_4 increasing bath temperature (60°-160° F.) was accompanied by decreasing hardness of the deposit. The hardness fell gradually from 70° to 100° F. and was lowest and practically constant from 100°-140° F. with a current density of 1 amp./in.^{2} At a current density of 2 amps./in.^{2} the hardness increased from 80° to 120° F. then decreased from 120° to 140° F. The deposit at 120° F. was 20 times as hard as that formed at 125° F. GBH (8d)

Replenishing the Metal Content of Cyanide Baths. Nathaniel Hall. *Platers' Guide,* Vol. 32, Feb. 1936, pages 17-18. Free CN is one of the determining factors in the maintenance of a good throwing power and NaCN or KCN must be added with the metal salt to keep it at its optimum value. A table shows the weights of NaCN (96-98%) to dissolve 1 lb. of metal salt. WHB (8d)

Separation of Zinc in Alternating Current Electrolysis (Separazione di zinco metallico nella elettrolisi con corrents alternata) V. Montoro. *La Metallurgia Italiana,* Vol. 27, Nov. 1935, pages 761-765. A deposit of Zn is obtained on both electrodes from a solution of 1 *N* $ZnSO_4$, by the passage of an a.c. (50 cycles) varying from 0.3 to 6 amps./dm.^{2} The total deposit on both electrodes is about 1% of the theoretical value (assuming d.c. used), about ⅔ depositing on the cathode, and ⅓ on the anode. The electrodes used were pure Zn. The deposit is crystalline without any preferential orientation. AWC (8d)

Electrodeposition of Tin Alloys from Alkaline Stannate Baths. R. G. Monk & H. J. T. Ellingham. *Transactions Faraday Society,* Vol. 31, Oct. 1935, pages 1460-1468. Satisfactory electrodeposits of SnNi alloys, containing Ni up to about 25%, were obtained with high current efficiencies from an alkaline solution containing 90 to 100 g. of Sn as Na stannate, 2 g. of Ni as K nickelocyanide and 5 g. KCN/l., with Ni anodes, and operated at 70-75° C. Deposits containing 18-25% Ni obtained at about 0.15-0.5 amps./dm.^{2} were bright until the thickness exceeded 0.0005", thicker deposits were mat. Their hardness is about 7 times that of electrodeposited Sn. Deposits of higher Ni content are very brittle. From baths containing 89 g. of Sn as Na stannate, 2 g. of Sb as Na thioantimonate/l., and with a free alkali concentration of about 0.1 *N*, operated at 70-75° C., with Ni anodes, deposits containing from 6.5 to 82.3% Sb were obtained with current density varying from 9.1 to 0.1 amps./dm.^{2} Only the alloys containing less than 50% Sb could be obtained as satisfactory deposits of thickness as great as 0.0005". The deposits are very brittle and, though harder than Sn, their resistance to wear is low. PRK (8d)

Optimum Metal Concentration of Nickel Solutions. D. A. Cotton. *Monthly Review American Electroplaters' Society,* Vol. 22, Dec. 1935, pages 6-31. Solutions containing, respectively, 2, 4, 6, 8, 10, and 12 oz./gal. of Ni, (as $NiSO_4$) were studied. These solutions were otherwise the same, i.e. contained 3 oz./gal. of $NiCl_2$ and 4 oz./gal. of boric acid. Measurements were made on each solution at 80° F. and at 120° F. at several current densities of (a) anode and cathode efficiencies, (b) anode and cathode polarization, (c) total voltage across cell, and (d) throwing power with the following results:

C.d. Range	2 oz.	4 oz.	6 oz.	8 oz.	10 oz.	12 oz.
Cold (Amps./ft.^{2})	8-13	10-25	15-40	15-40	15-50	15-45
Hot	10-20	15-30	20-65	15-80	15-90	15-90
Voltage range						
Cold (Volts)	3-4.5	3-6	3-7	3-7	3-8	3-7
Hot	3-5	3-5	3-8.5	3-9	2-9	2-9
Average cathode efficiency	99.5%	98.8%	98.6%	99.4%	99.3%	99.5%
Average anode efficiency	99.9%	99.0%	99.3%	99.5%	98.5%	99.7%
Average throwing power	31 %	25 %	30.7%	31.6%	30.5%	29.6%

Curves are given to show how each variable changed with increasing current density in each solution tested. A curve is given showing the effect of varying the pH on cathode efficiency. In a 2 oz./gal. of Ni solution the cathode efficiency is about 98% from pH 4.5 to pH 3.25. Below pH 3.25 the cathode efficiency falls rapidly until at pH 1.5 the efficiency is only 10%. In the case of a 12 oz./gal. of Ni solution the efficiency remains high from 4.5 to 2.0 pH, when it starts to fall off reaching a value of 45% at a pH slightly less than 1.0. The author concludes from these tests that hot Ni solutions can be run at higher metal concentrations than those now employed (which is about 7 oz./gal.) Higher current densities and shorter plating times would thus be obtainable. GBH (8d)

Nickel-plating Practice Abroad. W. T. Griffiths. *Aluminium & the Non-ferrous Review,* Vol. 1, Dec. 1935, pages 103-104. Compares current practice in U. S. A. with that on the continent of Europe. JCC (8d)

The Effect of Oxidizing Agents on Nickel Deposition. I. Hydrogen Peroxide and Nickel Nitrate. A. W. Hothersall & R. A. F. Hammond. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, Feb. 15, 1935, pages 201-202; Mar. 1, 1935, pages 251-254. Slightly condensed from a paper read before a joint meeting of the Faraday Society and the Electrodepositors' Technical Society, Dec. 1934. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 70L/6. HBG (8d)

Electroplating (Traité de Galvanoplastie) J. Salauze. Dunod, Paris, 1935. Paper, 6½ x 10 inches, 679 pages. Price 139.60 Fr.

The first 4 chapters cover in clear and simple fashion the older theories of electrochemistry. Then follow 2 chapters on the theory of the formation of electrodeposits and the influence of different factors upon the deposit. Cleaning methods and plating equipment are treated. The chapter on testing of deposits is of considerable interest. The latter half of the book deals with the theory and practice of plating Au, Ag, Cu, Pb, Sn, Ni, Co, Fe, Cd, Zn, Cr, and some of the less common metals.

As is the case frequently with French books, this is a well organized summary of facts and theories secured by other investigators. A surprising amount of the material is from the Transactions of the American Electrochemical Society—a most excellent source. The emphasis is on theory; the practical electroplater will find little of use in his day to day problems. H. W. Russell (8d) -B-

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Discussion on Chromium Plating Troubles. *Monthly Review American Electroplaters' Society,* Vol. 23, Jan. 1936, pages 38-46. Discussion at meeting of Electrodepositors' Technical Society, Birmingham, England, Nov. 1934. Suggested remedies for poor throwing power: (1) Increase of voltage to furnish more current to recessed portions of work although there is danger here of burning edges, (2) decrease of temperature as low as possible in the bright range, with the disadvantage of limiting current density, (3) maintenance of correct solution concentration, 250 g./l. (chromic acid) being favored, (4) increase of distance between anode and cathode, (5) use of auxiliary anodes, (6) use of a sulphate ratio of 100-130 to 1. On perforated articles, such as a tub overflow, Cr will not plate around the holes unless they are plugged. An easier method consists in placing an auxiliary anode behind the work. It is suggested that when Pb anodes are first placed in service they be given a coating of peroxide. Subsequent formations of Pb chromate can then be removed more easily. Peeling around soldered joints is attributed to melting of the solder under excessive polishing wheel pressure and was particularly noticeable in thin walled sections which quickly heated up and flowed the solder. Iridescent colors on Cr plate are stated to arise from sulphate content of the solution being too low. GBH (8d)

Control of Electroplating. *Steel,* Vol. 98, Jan. 27, 1936, pages 37-38; Feb. 3, 1936, pages 43-44, 69; Feb. 10, 1936, pages 36-38; Feb. 17, 1936, pages 44-45. Discusses: (a) relationship between weight of electroplated coating and its thickness; (b) recommended test for porosity; (c) determination of Ni, composite Cu and Ni, Cu, Cr, composite Cr and Ni, Zn and Sn, Ag, and Au coatings on ferrous and non-ferrous metals; and (d) a more flexible porosity test. MS (8d)

Economical Nickel Plating (Wirtschaftliches Vernickeln). Eugen Werner. *Oberflächentechnik,* Vol. 12, Sept. 17, 1935, pages 219-222. The 3 principal methods of Ni plating, i.e. ordinary plating in the stationary bath, rapid plating, and plating in the drum are discussed and their relative economical advantages compared. In all methods, to obtain good economy it is necessary that $NiSO_4$ is continuously formed at the anode and that the deposit has a certain fineness of grain. The hardness of the deposit must be such as to permit mechanical working without injury and the deposit must be favorable to easy Cr plating and must not peel. An ordinary stationary bath contains 75 g. Ni ammonium sulphate in 1 l. water with pH about 5.8. Increase in pH to 6.4 increases the throwing power of the bath, reducing it to 4.6 decreases the throwing power. Density of solution is 6-7° Bé, current density 0.3 amp./dm.^{2}, voltage 3.5, temperature 18° C. A thickness of 0.025 mm. is obtained in 7 hrs. A rapid plating bath must work at 50° C., the higher the electric conductivity of the bath the finer is the grain of the deposit. The compositions generally used are: 240 g. $NiSO_4$, 30 g. boric acid, 19 g. KCl in 1 l. water; or 240 g. $NiSO_4$, 120 g. $MgSO_4$, 30 g. boric acid; or 240 g. $NiSO_4$, 30 g. boric acid, 150 g. Na_2SO_4, 20 g. NaCl; or 200 g. $NiSO_4$, 100 g. $MgSO_4$, 10 g. NaCl, 50 g. Na_2SO_4, 0.1 g. NaF in 1 l. water. The current density must be adapted to the material to be plated. Pure Ni anodes do not dissolve as easily as 98% pure anodes. If the deposition velocity is too high an excess of O forms on the anode and passivates it and finally Ni bisulphate and peroxide are formed without Ni going into solution at all. Plating in the drum requires a pH of not less than 6.6, voltage is 8-12, time usually 2 hrs., bath temperature generally 35°-50° C. Ha (8d)

Electrode Potentials and the Form of Electrodeposited Metals. SAMUEL GLASSTONE. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1232-1237. Discussion page 1259. The author concludes that there must be some connection between the form of an electrodeposited metal and the electrode potential operative during the deposition. By reference to some of the factors involved it is shown that it is essential to analyze the experimental conditions to insure the absence of incidental factors which may obscure the results of any study to determine the connection referred to. 18 references. PRK (8d)

The Electrodeposition of Bronze Using Bi-metallic Anodes. C. BECHARD. *Technical Publications International Tin Research & Development Council,* Series A, No. 28, 1936, 8 pages. **Electrodeposition of Copper-tin Alloys. Use of Short-circuited Anodes.** *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Sept. 6, 1935, page 240. See "Electrolytic Deposits of Cu-Sn Alloys," *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 21L/7. HBG (8d)

The Determination of the Structure of Electrodeposits by Metallurgical Methods. D. J. MACNAUGHTAN & A. W. HOTHERSALL. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1168-1177. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 135L/9. PRK (8d)

Electro-deposited Zinc. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Sept. 7, 1934, page 173. See "Large-scale Electro-plating of Zinc," *Metals & Alloys,* Vol. 6, Jan. 1935, page MA 20L/7. MS (8d)

Influence of the Basis Metal on the Structure of Electrodeposits. A. W. HOTHERSALL. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1242-1247; *Engineering,* Vol. 140, Aug. 2, 1935, pages 127-128. Studies of the deposition of Cu, Ni and Sn on basis metals of Cu, brass, Ni, Fe, Sn, Sb and Ag showed that continuity of structure is possible when deposit and basis metal belong to the same crystal system with a range of differences in lattice parameters from —2.4 to +12.5%. Continuity of structure may also occur when deposit and basis metal belong to different systems. It appears probable that the high degree of adhesion obtained with electrodeposited coatings is associated with their ability to continue the crystal lattice of the metal base. 9 references. PRK + LFM (8d)

Practical Results of Electrodeposition Researches—Work of D S I R & B N F M R A Investigations. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Sept. 6, 1935, pages 237-239. A brief summary of the completed investigations that have been conducted at Woolwich Arsenal, Sheffield Univ., and the Royal Aircraft Establishment at Farnborough. Investigations discussed are: (1) hardness and polishing of Ni deposits, (2) pitting of Ni deposits, (3) effect of impurities in commercial solutions, (4) porosity of electrodeposits, (5) adhesion and stresses in deposits, (6) summarized information on Ni and Cr deposition (7) Ag deposition, (8) Cu deposition, (9) Cd deposits, (10) Sn coatings, and (11) stopping-off materials. HBG (8d)

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8e. Metallic Coatings other than Electroplating

Electrolytic Iron Provides Bond in Cladding with Special Alloys. RAYMOND R. ROGERS. *Steel,* Vol. 98, Feb. 10, 1936, pages 34-35. Describes recently developed process for covering inexpensive metals such as steel with a veneer of stainless steel, high-speed steel, Ni, or Stellite. In cladding with 18-8 Cr-Ni steel, 2 plates of 18-8 are placed back to back with a thin separating layer of Na_2SiO_3 containing talc or MgO. Plates, after being welded together around edges and degreased, are pickled anodically in 6*N* HCl at ordinary temperature with an anode current density of 60 amp./ft.^{2} until entirely free from non-metallic material. They are then rinsed, thoroughly scrubbed, and pickled anodically in the same bath just long enough to remove non-metallic material formed during scrubbing and are placed immediately in Fe plating bath without removing adhering acid. Bath contains 40 oz./gal. $FeCl_2.4H_2O$, 45 oz./gal. $CaCl_2$ and just sufficient HCl to prevent formation of a precipitate. Temperature of about 195° F. and cathode current density of 60 amp./ft.^{2} are used. Under these conditions, Fe is deposited at rate of about 0.003"/hr. The Fe coated 18-8 "double plate" is placed between two slabs of backing material and the assembly of 4 is seam-welded around edges. Combination is heated for about 1 hr. at 1750° F. to produce fusion weld between electrolytic Fe coating and 18-8 steel. It is then heated to about 2100° F. and rolled. Finally, the welded edges are sheared off. In cladding with high-speed steel, if preliminary anodic pickling in 6*N* HCl is required, this is followed by anodic treatment in an alkaline bath until gas evolution is entirely uniform over whole surface. Ordinary temperature and current density of 25 amp./ft.^{2} are used. Steel is dipped in HCl and then plated. Remaining procedure is essentially same as in case of 18-8. Stellite is treated anodically in 12*N* HCl at room temperature and current density of 60 amp./ft.^{2} until it is covered by a dark blue material. After rinsing, it is pickled by alkaline anodic treatment given high-speed steel. It is then given a short HCl dip and plated. After plating, composite metal is seam welded to a piece of backing material and whole is heated for some time at about 1750° F. and pressed together. MS (8e)

Kave

Cementation of Iron and Ferrous Alloys with Beryllium (Cémentation du fer et des alliages ferreux par le glucinium) J. LAISSUS. *Revue de Métallurgie,* Vol. 32, July 1935, pages 293-301; Aug. 1935, pages 351-360; Sept. 1935, pages 401-422. Cementation experiments made previously by Feszczenko-Chopiwski and by Cazaud are described. Possibility of cementation is shown by Wever and Mueller diagrams for Fe-Be system, indicating a closed γ loop. At room temperature a solid solution of α Fe containing 1.5-2.0% Be can be expected together with a eutectoid containing about 9.2% Be. Specimens were packed in a cementation mixture, powdered 98% Be or 80% Fe-Be, contained in a cylindrical receptacle closed with threaded plugs. This was placed in a second closed box filled with charcoal and cast iron borings which was used for preventing access of O_2 to the samples. An electric furnace with an automatic control was used for heating. Sections of samples of electrolytic Fe cemented in Be powder showed a case consisting of: an inner zone of solid solution, a layer of solid solution containing some eutectoid and an outer zone of hypereutectoid alloy containing much $FeBe_2$. The diffusion mechanism observed during cementation of C steels was similar to that observed in electrolytic Fe except that a more complex structure was observed in the steel. The constituents of the case observed on C steels in the outward order were: (a) zone with gradually decreasing pearlite content, (b) practically decarburized layer, (c) solid solution Fe-Be-C, (d) sharply defined hypoeutectoid layer of solid solution Fe-Be-C and a triple eutectoid, (e) eutectoid zone and (f) hypereutectoid zone. Cementation with 80% Fe-Be produced the same results as pure Be. For electrolytic Fe, the thickness of the case varied with the temperature, particularly above 1000° C., and with cementation time. 10-hour cementation at 1100° C. produced a 0.7 mm. case. In higher C steels the thickness of the decarburized layer passed through a maximum with increasing temperature and increased with cementation time, provided it was longer than 5 hours. The thickness of other layers increased directly with the temperature and time. For the same time and temperature C content had a retarding action on the depth of diffusion. Time effect did not depend on the composition of the base, though with 0.9% C the thickness of case ceased to be proportional to time. Hardness of case increased with C content, but is not a direct function of the temperature. Electrolytic Fe yielded 268 Vickers case, 0.9% C steel had a case with 1506 Vickers. Cementation with Be reduced the resistance of steel to scaling. It increased the resistance of steel to atmospheric corrosion, to the attack of fresh and salt water and to bleaching liquor. Good protection against HNO_3 was produced, provided the case was not cracked. Corrosion resistance to all other reagents studied was decreased. See also *Metals & Alloys,* Vol. 6, Mar. 1935, page MA 120R/8. JDG (8e)

Protective Coatings (Les revêtements protecteurs). J. COURNOT. *Métaux,* Vol. 9, Oct. 1934, pages 495-497. General discussion of preparation of materials for application of protective coating. GTM (8e)

Metallization (La Métallisation). S. FRANCOIS. *Métaux,* Vol. 9, Oct. 1934, pages 526-534. For coating by hot-processes immersion of the objects in a bath of molten metal is generally used, Zn at 500° C., Sn at 260° C. The Schoop procedure of metallization by spraying, a competitor in this field, has been thoroughly studied and discussed in literature to which one is referred. 69 references. GTM (8e)

Protection of Magnesium by Selenium Coatings (La protection du Magnesium par les revêtements de selenium). HENRI FOURNIER. *Métaux,* Vol. 9, Oct. 1934, pages 506-508. 9 references. Principle of method for applying Se coatings on Mg or light alloys consists in immersing the material in a solution containing selenious acid (free or salt) which, being very unstable, is reduced to metallic Se and deposited on the material. Many methods have been tried, and the following found to give similar results: (1) Immersion for 3 hours in an aqueous solution of 8% Na selenite, 3.2% selenious acid and 0.10% NaCl at 80°-90° C. (2) 10% selenious acid solution with 0.1-0.5% NaCl for 5-10 minutes. (3) 2% Na selenite solution with 0.2% H_3PO_4 for 1 minute. (4) Initial cleaning for 30 seconds in 1% chromic acid at 80° C. and then treated as in method 3. (5) Identical cleaning as in method 4 followed by method 2. GTM (8e) have

Cementation of Some Metals by Means of Chromium Powder. Tsutomu Kase. *Kinzoku no Kenkyu,* Vol. 12, July 1935, pages 357-390. In Japanese. The cementation of Fe and Ni with powdered Cr at temperatures between 800°-1300° C. was investigated. Studies were made of the depth of penetration, chemical composition, corrosion resistance to certain acids, microstructure, and resistance to oxidation. The following results were observed:—Diffusion of Cr into Fe and Ni commences at a temperature of 700° C, and the rate of diffusion increases with the rise of temperature, the increase being especially marked above A_3 (906°) for Fe. The relation between the weight increase, or the depth of penetration of the specimen and temperature of the cementation can be given by an exponential function,

$$W = a e^{\frac{-b}{T}}$$

where W denotes the weight increase, T the absolute temperature and a and b constants. The curve breaks into 2 branches at A_3 in the case of Fe. Similarly, the relation between the weight increase or the depth of penetration and the duration of cementation is given by an exponential function. The surface layer of Ni cemented with Cr resists oxidation at high temperatures as the alloy Nichrome does and also resists well corrosion by HNO_3. KT (8e)

Some Fundamental Considerations on Tinplate. W. E. Hoare. *Sheet Metal Industries,* Vol. 9, Apr. 1935, pages 201-204. Discussion of normal and potential pores in the tin coating pointing out the possibility that pores may develop from grease lines, mottle and dry patches and isolated $FeSn_2$ crystallites. AWM (8e)

The Use of Aluminium in Hot-Galvanizing. Heinz Bablik. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 9-10. Addition of Al in quantities of 1-2% to Zn in a hot-galvanizing bath gives a brighter and more flexible coating. A "dry" process, in which sheets are dipped in zinc chloride solution and dried before dipping is necessary; the usual salammoniac flux should not be used on the bath as it reacts with Al. JCC (8e)

Tentative Specifications for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses. *American Society for Testing Materials,* A. S. T. M. Designation: A120-34T; *American Standards Association,* A. S. A. No.: G8.7-1935, 6 pages. AHE (8e)

Longer Life for Galvanizing Furnaces. W. G. Imhoff. *American Machinist,* Vol. 80, Jan. 1, 1935, pages 18-20. Successful galvanizing furnace operation from the point of view of combustion, galvanizing and mechanical engineering is discussed and the forces of destruction in these 3 fields explained. Ha (8e)

Metallizing in Industry. H. R. Leland. *Refiner & Natural Gasoline Manufacturer,* Vol. 14, Dec. 1935, pages 567-570. Discussion of the practical aspects of metal spraying, particularly Al coating reaction chambers. VVK (8e)

B

Coating of Iron with Aluminum (Das Ueberziehen von Eisen mit Aluminium) *Oberflächentechnik,* Vol. 13, Jan. 7, 1936, pages 1-2. The 5 methods to produce an Al coat on Fe by (1) immersion in molten Al, (2) cathodic deposition by electrolysis, (3) rolling-on (plating) of Al, (4) spraying, and (5) heating in Al powder, are reviewed and their application and energy consumption discussed. Ha (8e)

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8f. Non-Metallic Coatings

Effect of Clays on the Opacity of White Enamel for Sheet Steel. R. R. Danielson. *Journal American Ceramic Society,* Vol. 19, Feb. 1936, pages 59-61. Effect of various types of clays on reflectance is shown, the variation may be 5% in some cases. When opacity and suspension of the clay in the enamel are important, a blend of clays having both properties may be used to improve workability in the draining or dipping of ware. WB (8f)

New Knowledge in the Lustrous Hot Coloring (of Metals) (Neue Erkenntnisse in der Lüstersudfärbung) G. Gross. *Zeitschrift für Metallkunde,* Vol. 27, Oct. 1935, pages 238-241. Metals may be given a lustrous colored finish ranging from yellow through brown to dark blue by dipping in a hot (80-95° C.) water solution of 124 g. $Na_2S_2O_3 . 5H_2O$ and 38 g. $Pb (C_2H_3O_2)_2 . 3H_2O$/l. This colors Cu, dark blue; Zn-bronze, brown; and Fe or steel, blue. Intermediate tones may be obtained by controlling the length of the dipping period. It is found that a more uniformly colored, denser, finer grained and more adherent coating is obtained by lowering the bath temperature and increasing the time accordingly. The time of dip required under these circumstances may be decreased materially by increasing the concentration of $Na_2S_2O_3 . 5 H_2O$, decreasing the quantity of $Pb (C_2H_3O_2)_2 . 3 H_2O$ and adding a weak acid such as acetic or argol. An old bath works faster than a new one. With a bath composed of 240 g. $Na_2S_2O_3 . 5 H_2O$. 25 g. $Pb (C_2H_3O_2)_2 . 3 H_2O$, and 30 g. argol/l. H_2O, it is possible to obtain a satisfactory tint on 63-37 brass in 12 minutes at room temperature. The results of a study of the influence of bath composition, temperature, time of dip and color are presented in graphical form. Discussion by Masing, Fischer, Gross, and Sterner-Rainer. FNR (8f)

Anodic Treatment and Dyeing of Aluminum Castings. N. D. Pullen. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 335-345. See *Metals & Alloys,* Vol. 5, Mar. 1934, page MA 105; July 1934, page MA 342; Oct. 1934, page MA 486. CEJ (8f)

A Method and Apparatus for Studying the Physical Properties of Vitreous Enamels on Steel. J. E. Rosenberg & A. Langerman. *Journal American Ceramic Society,* Vol. 19, Mar. 1936, pages 86-90. A split steel ring was enameled and fired, the ring being restrained from change in diameter during firing. The size of the opening when restraint was removed after firing gives an indication of stresses due to difference in coefficient of thermal expansion of enamel and steel. Stresses resulting from enamel applied to outside of ring and stresses produced by varying thicknesses of enamel coating were measured by amount of contraction of the ring. Theoretical considerations are discussed and method shown for obtaining absolute values of stresses required to close the ring after enameling. WB (8f)

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Chemical Developments in the Finishing Industries. J. M. Fain. *Metal Cleaning & Finishing,* Vol. 7, Mar. 1935, pages 117-120. Sprayed coatings of asphalt emulsions are being used on inside of automobile bodies to prevent rattling noises. Emulsion is made by pouring melted asphalt into a mixer together with a clay slip (bentonite). When the emulsion is applied as a surface coating, the asphalt separates out. This method of applying asphalt has worked in places where hot asphalt could not be used, such as on moist surfaces. Rubber-base paints are also discussed, good adhesion being claimed for them. Chlorinated rubber base paints have superior merits of resistance to acids and alkalies and strong adhesion to metal and concrete. GBH (8f)

Electron Diffraction Examination of Protective Films Deposited on Magnesium and Magnesium Alloys by the R.A.E. Dichromate Process. H. G. Hopkins. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 227-230. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 22R/1. (8f)

Lanolin Rust Preventers. C. Jakeman. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Oct. 26, 1934, page 291. Abstract from *Department of Scientific & Industrial Research—Engineering Research Board, Special Report* No. 12. See *Metals & Alloys,* Vol. 6, Apr. 1935, page MA 157L/4. MS (8f)

Investigations of the Phosphate Protection of Iron Obtained with the Biphosphates of Zinc, Iron, Manganese (Ricerche sulla Protezione fosfatica del Ferro ottenuta con Fosfati biacidi di Zinco, Ferro, Manganese) O. Macchia & G. Boggio. *Industria Meccanica,* Vol. 17, Sept. 1935, pages 817-821; Oct. 1935, pages 906-909; Nov. 1935, pages 991-995. Numerous tests were made to find the principal factors which determine the protective action of phosphate coatings against atmospheric influences with solutions of the biphosphates of Fe, Zn, Mn, Fe-Zn, Fe-Mn, Zn-Mn. The general conclusions can be summarized as follows: Zn phosphate solution, about 3.0%, offers a good protection but requires too long time (55 min.) for its action. Solutions with 3.5% Mn biphosphate are good, and more rapid. Fe biphosphate cannot be used as it affords no appreciable protective value. Fe-Zn biphosphate solutions of 3% give excellent protection. Zn-Mn biphosphate in 4% concentration and high in Mn biphosphate is satisfactory both from the point of view of protection and duration. Fe-Mn biphosphate solutions having 3.5% concentration and more than 70% of the solute consisting of Mn biphosphate give the best results both in behavior of the protective surface and in rapidity of treatment. The last is recommended for practical applications. Procedures are described in detail. 41 references. Ha (8f)

Chemical Protection (Les protections par voie chimique). Jean Bary. *Métaux,* Vol. 9, Oct. 1934, pages 503-505. Parkerizing for ferrous materials and protalising for Al are generally discussed. GTM (8f)

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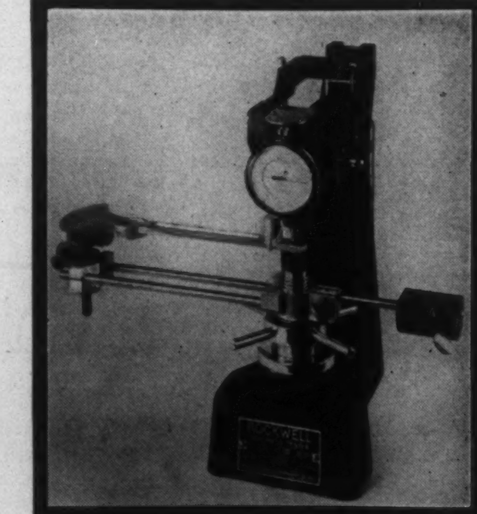

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9. TESTING

Some Defects Observed in Service on Bent Locomotive Shafts (Note sur certains défauts constatés en service sur les essieux coudés de locomotives) ALBERT PORTEVIN. *Revue de Métallurgie,* Vol. 33, Mar. 1936, pages 209-214. Failures investigated were attributable to flakes in steel opened by strains.
JDG (9)

Optical Research on Evaporated Metal Layers. L. S. ORNSTEIN. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1158-1168. Includes discussion. It is shown how total reflectivity can be found in a single experiment. The accuracy of the absorption is entirely independent of the form and condition of the surface. The generalization that if a piece of any material is illuminated homogeneously, the ratio of the intensity of the light leaving the material in a particular direction A to the intensity of the incident light is equal to $I - a_A$ where a_A represents the total absorption for the light incident along A. There have yet to be investigated errors which may arise in the proposed experiment if the illumination is not perfectly homogeneous.
PRK (9)

Technical Schools and Research Laboratories of the Foundry Trade in Germany and France (Ecoles Techniques et Laboratoires de Recherches dans l'Industrie de la Fonderie en Allgemagne et en France) L. PERSOZ. *La Revue Industrielle,* Vol. 66, Feb. 1936, pages 71-72. Conditions in the 2 countries are compared and it is concluded that although they are different, somewhat comparable results are obtained.
FR (9)

Application of Microchemistry to Metallurgical Studies (Sur les applications de la microchimie aux études métallurgiques) CARL BENEDIKS & RAGNAR TREJE. *Revue de Métallurgie,* Vol. 33, Mar. 1936, pages 203-208. Survey of the contemporary state of microchemical investigation of metals based on 112 references.
JDG (9)

The Validity of Drude's Optical Method of Investigating Transparent Films on Metals. LEIF TRONSTAD. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1151-1158. Discussion begins on page 1166. A review of the optical method of Drude for examination of thin transparent films is given. The validity and applicability of the method for a wide range of surface problems are discussed. The limitations are not yet thoroughly investigated. 21 references.
PRK (9)

9a. Inspection & Defects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

Stress Analysis by X-ray Diffraction. C. S. BARRETT & M. GENSAMER. *Physics,* Vol. 7, Jan. 1936, pages 1-8. A general mathematical treatment of the problem of determining surface stresses in a metal by means of X-rays is given. Included as special cases are the determination of uniaxial stresses or the sum of 2 principal stresses in the plane of the metal surface, and the treatment is extended to determining each of these 2 individually. The optimum operating conditions are given and probable errors evaluated. Under the best conditions these should be about 1300 lbs./in.^{2} for Fe and 320 lbs./in.^{2} for duralumin. Various camera designs are suggested and the practical applications discussed.
HFK (9a)

X-ray Measurement of Elastic Stresses (Röntgenographische Messung von elastischen Spannungen) R. GLOCKER. *Zeitschrift für Metallkunde,* Vol. 27, Sept. 1935, pages 196-198. With discussion. A simple geometric treatment of the measurement and resolution of stresses is given. It is shown how this may be accomplished by X-rays with photograms taken from 3 different directions. This method allows the determination of stresses within very small areas without destruction of the sample, but it can be applied to the exposed surface only.
GD (9a)

X-ray Examination of the Fine Structure in Foundry Practice (Die röntgenographische Feingefügeuntersuchung in der Giessereipraxis) A. KARSTEN. *Giesserei,* Vol. 23, Jan. 31, 1936, pages 57-59. Principles and characteristics of examination of the fine structure (crystalline structure) by means of X-rays are explained and equipment described. The application to shop practice is discussed.
Ha (9a)

Stereometric Measurements on X-ray Photographs (Stereometrische Messungen an Röntgenaufnahmen) A. MATTING. *Giesserei,* Vol. 23, Jan. 3, 1936, pages 7-11. The application of the stereoscopic principles in X-ray photographs and the determination thereby of the exact location of defects in the material is explained in detail. Some existing apparatus for this purpose is described. Ha (9a)

Radium as a Means of Inspection. J. F. SPRINGER. *Machinery,* N. Y., Vol. 42, Feb. 1936, pages 402-403. The use of γ rays of Ra in inspection for detecting flaws in heavy forgings and castings, and the equipment used industrially are described.
Ha (9a)

Radiographic Inspection of Metal Products. H. R. ISENBURGER. *Modern Machine Shop,* Vol. 8, Mar. 1936, pages 31-38, 162-170. Principles of application of radiology to metallurgical problems are explained, modern equipment procedure described, and examples of radiographs and their evaluation given.
Ha (9a)

What Is a "Pock-Mark" in Steel? J. S. GLEN PRIMROSE. *Edgar Allen News,* Vol. 14, Feb. 1936, page 797. So-called "pock-marks" appear on the fractured surface of pulled test bars and are small dark colored dots with radial markings set in the lighter gray face of the steel. By cutting longitudinally through these marks and etching and polishing the section one can recognize that there was evidently a slag inclusion or some P at that place. As the material is less ductile at that point, fracture starts there.
Ha (9a)

Some Unusual Causes of Shaft Failures. Edward Ingham. *Mechanical World & Engineering Record,* Vol. 98, Nov. 22, 1935, pages 498, 502. In many cases the causes of shaft failures are hard to find. Unless the real reasons are established there is a tendency for over expense in corrective measures. Examples are given which will afford a lead for examining obscure cases. WH (9a)

Detection of Oxide Inclusions in Steels by Imprint Methods (Ueber den Nachweis von Oxydeinschlüssen durch Abdruckverfahren) R. Mitsche. *Berg- und Hüttenmännisches Jahrbuch,* Vol. 83, Dec. 23, 1935, pages 127-133. The practical importance of detecting non-metallic inclusions in steel is explained and the method of M. Niessner described which permits making photographic prints of iron oxide inclusions. A gelatine-coated paper is impregnated with a solution of HCl in H_2O (1 : 20), the section then pressed onto the paper and the latter developed in a ferrocyanide potassium solution (20 g./l. H_2O). Influence of kind of gelatine paper, developing conditions and least magnitude which can be detected are discussed. Ha (9a)

Sampling and Inspecting Steel. J. H. Hruska. *Heat Treating & Forging,* Vol. 22, Feb. 1936, pages 71-73. Deals with determination of quality of ingot-steel. Discusses test ingots; taking drillings for chemical analysis; macrographic etching of ingot sections; sulphur printing; fracture tests; and shear tests. MS (9a)

Failure of Parts in Service. Eugene W. Nelson. *Heat Treating & Forging,* Vol. 22, Feb. 1936, pages 63-65. Discusses briefly fractures caused by torsion, shear, impact, compression, bending, and fatigue, with chief attention to the last. Outlines theories of fatigue failure by slip and by stress raisers. MS (9a)

Industrial X-Ray Practice. Robert C. Woods. *Electronics,* Vol. 9, Feb. 1936, pages 7-11. A review of the present-day uses of X-rays in production, testing, inspection, and industrial research. Contains some practical information on the necessary equipment and the cost of its installation. DJM (9a)

X-ray Testing of Welds. II. E. L. Mathy. *Industry & Welding,* Vol. 8, Jan. 1936, pages 31, 34-35. Testing principles for X-rays and gamma rays, and protection for the operator from the harmful effects of the rays are explained. Ha (9a)

Absorption of Short Wave-length X-rays. W. V. Mayneord & J. E. Roberts. *Nature,* Vol. 136, Nov. 6, 1935, page 793. Measurements of mass absorption coefficients of 18 elements for X-rays from 250 kilovolt constant potential X-ray tube when filtered through 3 mm. Pb, 2 mm. Sn, and 3 mm. Al. CSB (9a)

The Relation Between Density of Blackening and X-Ray Intensity for Characteristic Copper Radiation and Agfa-Laue Film. F. D. Miles. *Transactions Faraday Society,* Vol. 31, Oct. 1935, pages 1452-1460. The density of blackening of Agfa-Laue film by characteristic Cu radiation may be taken to be proportional to the X-ray intensity up to a density of 1.0. The error involved is at the most 4% of the highest density measured. There is no evidence of threshold effect. 13 references. PRK (9a)

■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

International Standardization of Notched Bar Impact Test. Experimental Study of the Influence of the Depth of Notch (Normalisation internationale de l'essais de flexion par choc sur barreaux entaillés. Etude expérimentale de l'influence de la profondeur d'entaille) Etienne Dupuy, Jacques Mellon & Pierre Nicolau. *Revue de Métallurgie,* Vol. 33, Jan. 1936, pages 55-70; Feb. 1936, pages 133-139. Committee 17 of the International Standards Association proposed during its meeting at Düsseldorf in 1933 the standardization of the shape of the impact bars used for determination of impact strength. The dimensions of 10 x 10 x 55 mm. were generally agreed upon as well as the U-shaped notch with a radius of 1 mm. The depth was left open until further study. The present investigation determines the influence of this depth. 5 alloy and 5 plain C steels all properly heat treated to give the widest possible range of impact values were used as samples. Impact test bars were cut of hot rolled stock in a way to produce the most representative samples, machined almost to size, heat treated, machined to size and notched. Both U-shaped and V-shaped notches were used, the latter was a 90° notch with an 0.25 mm. radius. They were tested at room temperature in a Charpy machine. The depths of U-notches studied were 2, 3, 4, 5, 6, 7, 8 mm. and of V-notches 3 mm. A further study included U-notches which had depths of: 0, 0.6, 1.3, 2, 3, 4, 5, 6, 7, 8, 8.6 and 9.2 mm. The results obtained are given in figures and curves. They were compared with data of A. Steccanella, *Metallurgia Italiana,* Feb. 1935, page 81, and of R. Mailänder *Stahl und Eisen,* Vol. 55, 1935, pages 749, 779. When the fracture is coarsely crystalline, the depth of a notch does not have any effect. When specimens break with a tough fracture, the impact value is a linear function of the depth of the notch, $K = K_1 + Ah$ where K_1 is a constant which can be considered in the first approximation as independent of the nature and state of the metal. With greater depths of h and with tough steels the values obtained deviate upwards from the theoretical, the more the higher is the impact strength of the steels. In brittle steels lower values of h tend to raise curves which apparently corresponds to the influence of a tough surface layer. Scattering of relative values obtained on carefully machined samples is independent of the depth of the notch, but the absolute values are substantially proportional to h. Any depth of notch leads to the same classification of steels. V-notch used in these experiments gives the same results as U-notches. For the same depth of notch, impact strength is diminished by V-notch. The ratio between impact strength obtained with a 5 mm. U-notch and a 3 mm. V-notch is slightly greater than 1 up to $K = 9$. Above this the ratio drops below 1 and decreases rapidly. A 10 x 10 x 55 mm. test bar with a U-notch 5 mm. deep has a marked superiority over the same bar with a 2 mm. U-notch. The same bar with a 3 mm. U-notch does not offer any special advantages but very tough steels call for a special notch. JDG (9b)

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Photoelastic Study of Stresses Due to Impact. Ziro Tuzi & Masataka Nisida. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 21, Feb. 1936, pages 448-473. A cinematographic method of photographing impact phenomena on vibrating specimens of phenolite with exposures of 1/5000-1/50,000 sec. is described. The max. stress produced by impact was found to be 80-90% of the calculated value. See also *Metals & Alloys*, Vol. 6, Sept. 1935, page MA 368R/8. Ha (9b)

Study of Forging Qualities. Investigation of Laboratory Testing (Contribution a l'étude de la forgeabilite recherch d'un essai de laboratoire) Albert Portevin, Etienne Pretet & Jean de Lacombe. *Revue de Métallurgie*, Vol. 33, Feb. 1936, pages 114-132. Steels containing 0.08% C, 0.32 Si, 0.31 Mn, 0.020 S, 0.018 P, 0.14 Cu; 0.03 C. 0.02 Si, 0.1 Mn, 0.018 S, 0.002 P, 0.012 O; 0.08 C, 0.43 Si, 1.39 Mn, 40.78 Ni; 0.03 C, 0.3 Si, 0.015 Mn, 40.70 Ni; 0.40 C, 1.31 Si, 0.08 Mn, 12.35 Cr, 13.16 Ni, 2.25 W and brasses with 58.80 Cu, 38.18 Zn, 1.64 Pb, 0.52 Sn, 0.70 Fe; 64.90 Cu, 34.50 Zn, 0.04 Pb, 0.06 Fe, 0.07 Sn were tested for torsion, compression, bending, tensile strength, impact strength and compression by an impact. Steels were tested at intervals of 100° between 600° and 1300° C., brasses between 300° and 800° C. Curves for the properties obtained are given. The results obtained cannot be interpreted using a uniform method. Special considerations should be applied to every different case. JDG (9b)

Dynamics of the Tensile Test (Zur Dynamik des Zerreissversuchs) W. Späth. *Messtechnik*, Vol. 12, Feb. 1936, pages 21-25. The tensile test is a static test strictly, only over the elastic range of the specimen, beyond this range flow phenomena occur which make the test an entirely dynamic one. The oscillations in the machine and specimen in this range are explained and the theory for machines with weights and hydraulic testing machines is developed. Conditions can be set up during a test, especially in the former class, where the specimen is subject to considerably higher stresses than calculated in the usual manner for static conditions. Improvements in the design of testing machines are suggested to reduce oscillations as much as possible. Ha (9b)

Marblette for Photoelastic Models. A. G. Solakian. *Product Engineering*, Vol. 7, Mar. 1936, page 107. A new material called "Marblette" of high mechanical strength and optical sensitivity for transparent models for photoelastic tests is described. The available materials for this purpose, and the stress in lbs./in.² to produce one fringe/in. of thickness, and the strength in lbs./in.² are:

Material	fringe stress	elastic limit
marblette	23	2750
phenolite	55	7000
bakelite	70	5500
celluloid	205	4000
glass	1150	——

Marblette is a phenolic material which can be obtained in liquid or plastic form and cast to shape. Ha (9b)

Sectional Strength (Die Gestaltfestigkeit) A. Thum & W. Bautz. *Stahl und Eisen*, Vol. 55, Sept. 26, 1935, pages 1025-1029. The suitability of a material for machine parts depends very largely on the shape of the section and the type of notch effect involved. Test pieces of various materials should, therefore, be made and tested, having the actual shapes to be used. The notch sensitivity of the material should also be determined. SE (9b)

General Survey of Tests for Determining Properties of Aluminum Castings (Coup d'oeil général sur les éssais effectués en vue de determiner les charactéristiques des pièces de fonderie en aluminium) A. von Zeerleder. *Revue de Métallurgie*, Vol. 33, Jan. 1936, pages 1-6. Tensile testing is the best method for evaluating properties of castings, but multiplicity of factors entering casting practice makes representative sampling very difficult. Separately cast test bars made under rigidly standardized conditions appear to be more advantageous, particularly when they are cast in a horizontal position. JDG (9b)

A Deep-drawing Test for Aluminium. A. G. C. Gwyer & P. C. Varley. *Journal Institute of Metals*, Vol. 58, Jan. 1936, pages 7-16 (Advance Copy No. 715). A newly developed test for determining the deep-drawing qualities of Al and Al alloys is described. It consists in 2 drawing operations, in which the first is a cupping operation and the second is a redraw of the cup formed. The test distinguishes between different tempers of the metal. The test proved that Al sheet of medium tempers had very good drawing properties and it is suggested that medium-temper sheet should be used more extensively for deep drawing. 11 references. JLG (9b)

Relationships in Cast Iron Test Results. G. L. Harbach. *Engineer*, Vol. 160, Sept. 6,1935, pages 251-252. See *Metals & Alloys*, Vol. 7, Mar. 1936, page MA 139L/2. LFM (9b)

Effect of Stretching and Aging on the Behavior of Steel Under Alternating Stresses (Einfluss von Recken und Altern auf das Verhalten von Stahl bei der Schwingungsbeanspruchung) F. Körber & M. Hempel. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung*, Vol 17, No. 22, 1935, pages 247-257. Experiments on the effect of thermal and mechanical aging of cold-deformed steels (5 and 10%) on the static tensile strength and alternating strength under bending and tension-compression stress, on the damping qualities of the material and on metallographic and X-ray tests are reported. A cold-deformation of 5-10% without aging treatment reduces notch-toughness considerably; thermal aging reduces this value still more. Aging treatments have different effects on the mechanical properties, this is very likely due to the fact that thermal and mechanical (natural) aging must be ascribed to different causes. The tests are described in detail. 24 references. Ha (9b)

International Standardization of the Notched-Bar Impact Specimen (Internationale Vereinheitlichung der Probenform für Kerbschlagversuche) R. Mailänder. *Stahl und Eisen*, Vol. 55, Dec. 5, 1935, pages 1456-1458. A series of test results are given to check the results of A. Steccanella on 10 x 10 x 55 mm. notched-bar impact specimens with 2, 3, and 5 mm. deep notches. The scatter was about the same for all 3 types. The German specimen with 1 mm. diameter notch appears to possess no advantages. SE (9b)

Model Experiments in Stress Distribution. William Hope Harnett. *Journal & Transactions Institution of Engineers of Australia*, Vol. 7, Oct. 1935, pages 345-354. The paper reviews a number of methods in which models are used for the experimental study of complicated stress distributions, special attention being given to application of photo-elasticity and to recent developments in "analogy" methods. WH (9b)

Measurements on the Open-hearth Furnace (Messungen am Siemens-Martin-ofen) W. Liesegang. *Archiv für Technisches Messen*, Vol. 5, Dec. 31, 1935, pages T165-T166. Correct arrangement of temperature measurements in furnaces, in particular the open-hearth furnace, is explained; measurements must be made (1) to obtain rapidly the maximum admissible temperature required for the process, (2) to insure the greatest possible uniformity of temperature on the hearth, (3) to prevent the recuperating or regenerating installation from becoming too hot, and (4) to avoid uneconomical utilization of the waste gases. Arrangement and types of instruments to use for temperature, pressure and draft measurements, for gas and air quantities, and for gas analyses are discussed. 16 references. Ha (9b)

Which Form of Test Piece is Best Suited for Impact Tests (Vilken slagprovstav har utsikt att sla igenom som normalstav?) Gunnar Malmberg. *Jernkontorets Annaler*, Vol. 119, Nov. 1935, pages 455-482. The author concludes that a test piece 10 x 10 x 55 mm. with a slit in the center of 3 mm. depth and 2 mm. width is preferable because it gives more consistent readings than test pieces with slits of the same width but depths of 2 mm. or 5 mm. HCD (9b)

Actual Problems in Testing Methods for Light Metals (Aktuelle Probleme bei Prüfungsmethoden von Leichtmetallen) M. Ros *Aluminium*, Vol. 17, Dec. 1935, pages 631-637. The present status of technological testing of light metals, the various methods and their particular purpose are discussed and classified, terms defined and the preparation of test specimens described; the dimensions are given in sketches. It is emphasized that material testing and experience are one indivisible unit; the testing of materials in the laboratory, supervision during production and manufacture, and experience made on the finished structure must always be correlated to obtain the greatest benefit for the progress of industry. Ha (9b)

The Problem of Retirement of Wire Rope from Service. B. M. Suslov. *Wire & Wire Products*, Vol. 11, Jan. 1936, pages 19-21, 48. An outline is given of Russian practice to determine the life of a wire rope so that it can be replaced in time. The method to determine the degree of deterioration of a stranded rope is based on the investigations of R. Woernle and is described in full. Ha (9b)

The Design and Equipment of Photo-elastic Laboratories. With a Brief Introduction on the Elements of Photo-elasticity. E. G. Coker. *Journal & Record of Transactions Junior Institution of Engineers*, Vol. 45, Apr. 1935, pages 291-318. See *Metals & Alloys*, Vol. 6, Sept. 1935, page MA 368L/10. WH (9b)

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9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

The Load-Deflection Fatigue Test. A Critical Investigation of Its Application to Steels. J. W. CUTHBERTSON. *Iron & Steel Institute, Carnegie Scholarship Memoirs,* Vol. 24, 1935, pages 1-50. A load-deflection short time test is described. This enables fatigue values of ferrous materials to be determined which are in excellent agreement with the true endurance limits. The test is satisfactory up to temperatures of 300° C. The best results are obtained when: (1) The specimen is first subjected to a preliminary treatment in which an alternating stress approximately equal to the fatigue value is applied until a constant strain is reached. Usually about 200,000 reversals are satisfactory, and at 2500 r.p.m. the time required is about 1 hour. (2) The amplification system is such as to allow the deflection of the end of the bar to be measured to less than 0.00005". (3) The specimen is uniformly stressed over a considerable portion of its length. Solid rod specimens suitably tapered over the center portion of their length were found to fulfill this condition quite satisfactorily. In addition, the author shows that deflection tests under constant load may be useful in rapidly determining fatigue values. Less than 4 hours is usually sufficient to indicate whether the applied stress is above, below, or equal to the fatigue stress. Hollow specimens such as were used by the author are not recommended since easily produced solid rods of similar dimensions give practically as satisfactory results. The materials studied were plain C, Ni case-hardening, and stainless steels. Stainless Fe was also tested. The stress frequency was usually 2500 r.p.m., and the continuous rate of loading was 1 lb./min. in most of the load-deflection tests. Rates of loading between 0.5 and 1.5 lbs./min. gave the best results. The author believes that the disappointing results obtained using certain non-ferrous metals and alloys in load-deflection tests are largely due to a poor definition of the exact point at which the load-deflection curve departs from linearity, and therefore he believes that if the factor of strain amplification were increased, much closer agreement between the load-deflection fatigue and true endurance values would result. 19 references. (Note by H.F.M. The load-deflection test as well as various other short-time tests have been found by various investigators to be fairly reliable in determining the fatigue limit for the ordinary ferrous metals. So far none of these short-time tests have proven reliable for determining the fatigue limits of non-ferrous metals. It is to be hoped that the author will make careful tests on some non-ferrous metals (including duralumin) and on austenitic steel. Until such data are available it is difficult to accept the load-deflection test as superior to several other proposed short-time tests for fatigue strength, or to regard any of them as reliable for general use). CW (9c)

Endurance Tests on Welded and Brazed Joints (Essais de Fatigue sur Assemblages Soudés et Brasés) L. DOUSSIN. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Nov.-Dec. 1935, pages 1939-1959. Lecture before the French Welders' Society. Tests have been made on Cr-Mo steel. Results deal with the following points: (1) Effect of temperature on endurance limit. For fusion welding it is difficult to establish decrease of endurance limit due to temperature. For bronze welding, endurance limit is 13.5-15.5 kg./mm.^{2}, for brazed tubes 16 kg./mm.^{2}, for silver brazing 13.7 kg./mm.^{2} on steel and 11.3 kg./mm.^{2} on brass. With soft solder, higher endurance limit obtained is 20.3 kg./mm.^{2} (2) Effect of stress distribution at points of thickness changes (when reinforcing sleeve is used). (3) Effect of over-lapping length and of joint length. Study leads to conclusion that static tests cannot give a value for endurance limit, a conclusion in accord with the findings of many previous investigators. All kinds of joining give a sufficiently high endurance limit so that none of them has to be discarded even the old ones which have been superseded by up to date joining processes. FR (9c)

Endurance Testing (Bemerkungen zur Durchfuhrung von Dauerversuchen) W. SPÄTH. *Metallwirtschaft,* Vol. 15, Jan. 24, 1936, pages 91-93. In determining the endurance strength by decreasing and increasing loads the latter method gives higher results. A model, consisting of a spring bridge balanced by a resistance element, is used to analyze the 2 testing methods and determine which is most valid. With decreasing loads 2 effective forces exist, the decreasing internal stress and an increasing force due to overstress at imperfections. Quite variable results will be obtained as the damping characteristics of the material must become constant. With increasing loads the critical internal stress is not exceeded locally, self-hardening occurs, and a value is obtained which is much more closely related to equilibrium conditions. This sort of self improvement of the material may be obtained by either static or dynamic loading and might well be used in practice. (Note by H.F.M. It seems doubtful whether endurance strength under repeated loading could be determined by the method outlined. The "self improvement" of the metal to which reference is made is probably due to cold work, and this improvement often overbalances the damage due to the beginnings of a spreading crack during the first few hundred applications of load. It is difficult to see how the test method outlined above could be used to detect the early stages of a spreading fatigue crack). GD (9c)

Calculation of the Endurance Limit of Notched Bars from the Tensile Strength and Reduction of Area (Berechnung der Kerbdauerfestigkeit aus Zugfestigkeit und Einschnürung) G. ERBER. *Archiv für das Eisenhüttenwesen,* Vol. 9, Aug. 1935, pages 95-97. On the ground that the endurance limit of notched bars depends both on the ordinary tensile strength and the deformability, the repeated impact resistance is expressed as a function of the tensile strength × the reduction of area. Data taken from the literature on various C and alloy steels appeared to indicate that for certain values of the tensile strength × reduction of area the endurance limit of notched bars can be calculated to within about ± 10%. (Note by H.F.M. The suggestion of determining fatigue strength from the results of a static tension test has frequently been made, and various methods have been devised which give fairly good indications of fatigue strength for the common ferrous metals. However, none of the methods with which the writer of this note is aware have been found reliable for non-ferrous metals, and their reliability for such ferrous metals as the austenitic steels is not yet proven). SE (9c)

9d. Magnetic Testing . . .

L. REID, SECTION EDITOR

Relation of Temperature to Spontaneous Magnetization (Über die Sogenannte Temperaturabhängigkeit der Spontanen Magnetisierung) KOTARÔ HONDA & TAMOTSU NISHINA. *Zeitschrift für Physik,* Vol. 98, Feb. 3, 1936, pages 657-665. Theoretical aspects of magnetic forces are discussed from measurements made of the residual magnetism of a single Fe crystal across the 3 principal axes at different temperatures. FHC (9d)

Magnetic Properties and Orientation of Ferromagnetic Particles. II. Pyrrhotite. C. W. DAVIS. *Physics,* Vol. 6, Dec. 1935, pages 376-379. The changes of magnetic properties of granular pyrrhotite by particle orientation and heat treatment are discussed and attendant data given. Heat treatment, while causing no chemical change in this mineral, causes increased induction and remanence and decreased coercive force. Particles aligned parallel to the magnetizing field show greater induction and remanence but less coercive force than randomly oriented particles. Cross-oriented particles showed lowest induction and remanence but the greatest coercive force. The effect of orientation on the magnetic properties is different for pyrrhotite than for magnetite. HFK (9d)

Coercive Force of Magnetite Powders. V. H. GOTTSCHALK. *Progress Reports—Metallurgical Division. 10. Mineral Physics Studies. United States Bureau of Mines, Report of Investigations* No. 3268, Feb. 1935, pages 83-90. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 369L/9. AHE (9d)

Magnetic Properties, Report of Committee A-6. THOMAS SPOONER, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 104-106. Progress report. VVK (9d)

Change in Magnetic Susceptibility of Metals During Melting and Allotropic Transformation. K. HONDA & Y. SHIMIZU. *Nature,* Vol. 136, Sept. 7, 1935, page 393. New measurements, in vacuum, of the changes with temperature of magnetic susceptibility of Sn, Cu, Au, Ag and comparison of results with theories. CSB (9d)

Magnetism of Copper. S. RAMACHANDRA RAO. *Nature,* Vol. 136, Sept. 14, 1935, page 437. The magnetic susceptibility of colloidal Cu is greater than that of the massive metal. The critical diameter below which the susceptibility increases rapidly is 0.8 μ. Colloidallization has the same effect as cold working. CSB (9d)

Diamagnetism of Thallium Single Crystals. S. RAMACHANDRA RAO & K. C. SUBRAMANIAM. *Nature,* Vol. 136, Aug. 31, 1935, pages 336-337. Magnetic susceptibility of Tl is 0.407 (10^{-6} units) parallel to hexagonal axis and 0.163 perpendicular to it, giving unusually large anisotropy. The average for polycrystalline Tl is 0.244. Upon transformation of the crystal to the cubic system at 235°, susceptibility suddenly becomes isotropic at 0.170; a further decrease to 0.153 occurs on melting (302° C.). CSB (9d)

Abnormal Magnetic Behavior of Treated Cobalt Wire. T. F. WALL. *Nature,* Vol. 136, Sept. 7, 1935, page 397. A Co wire was heated for a few seconds at 1200° C. in H_2 by a 50-cycle alternating current. After cooling the saturation value of the intensity of magnetization and the maximum permeability is increased. If the treatment is continued several hours the saturation magnetization is reduced to 60% of normal and the maximum permeability is lowered greatly. CSB (9d)

9e. Spectrography

Spectroscopic Analysis of Steels—The Influence of Non-Homogeneous Samples. W. R. BRODE. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 47-52, discussion pages 53-56. Detailed data are given on a series of composite samples and lines determined for Sn, Ni, Mn, Cr, and Cu. A comparison is made between the log-sector and the density-photometry methods. VVK (9e)

The Use of the Spectrograph in the Platinum Industry. H. E. STAUSS. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 57-60. The use of the spectrograph in the Pt industry is discussed from the standpoint of (1) identification of alloys, (2) special analyses for minor impurities, and (3) control of the purity of Pt and its alloys for special purposes. VVK (9e)

The Spectrographic Detection and Estimation of Minute Quantities of Impurities in Copper. M. MILBOURN. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 275-282. Includes discussion. See *Metals & Alloys,* Vol. 6, Feb. 1935, page MA 68R/5. (9e)

A "Synthetic Spectrum" Method of Analysis and Its Application to the Quantitative Estimation of Small Quantities of Bismuth in Copper. D. M. SMITH. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 283-290. Includes discussion. See *Metals & Alloys,* Vol. 6, Feb. 1935, page MA 68R/4. (9e)

The Spectrographic Analysis of Aluminium. D. M. SMITH. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 257-272. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 293L/6. (9e)

The Spectrographic Analysis of Some Alloys of Aluminium. ERNEST H. S. VAN SOMEREN. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 265-274. Includes discussion. See *Metals & Alloys,* Vol. 6, Apr. 1935, page MA 163L/6. (9e)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Studying Gear Steels with the Microscope. John T. Horat. *Machine Design*, Vol. 7, Dec. 1935, pages 29-31. Heat treatment and resulting physical properties in relation to microstructure are considered. WH (10)

The Diffusion of Non Metallic Elements in Iron and Steel. Arthur Bramley, Frederick Wardle Haywood, Arthur Thomas Cooper & John Thomas Watts. *Transactions Faraday Society*, Vol. 31, May 1935, pages 707-734. The diffusion of S, O_2, P and the effect of O_2 on diffusion of N_2 were studied. Using Swedish iron 0.03% C, .08% Mn, .008% P, .01% S and tr. Si, and exposing to 0.8-1.0% H_2S in H_2 followed by intermittent exposures to H_2 alone over a period of 40 hours, the following data were obtained:

Temp. °C	Temp. ° Abs.	Diffusivity of S K x 10^{10}
950	1223	3
1000	1273	5.5
1050	1323	7.0
1100	1373	10.0
1150	1423	13.0

The data do not fit perfectly the equation $\log K = \frac{A}{T} + B$. Using steels with 0.125%, 0.410%, and 0.965% C, 0.050%, 0.080% and 0.180% S, (Mn, Si and P being fairly uniform) the rate of diffusion of S in steel was found to be greatly reduced by C. 50 points increase in C halved the diffusion rate. The diffusion of S in Fe and steel follows Fick's law. The diffusivity constants are less than 1/300 that of C and N_2. The presence of S depresses markedly the diffusion of C in metal. The diffusion of O_2 was not easy to follow. Using deoxidation data from Armco Fe the diffusivity constant of O_2 in Fe was found to be 7.5×10^{-10} at 1000° C. The presence of dissolved Fe oxide has a slight but definite lowering effect on the rate of diffusion of C in steel. This effect is much less than the effect due to S. The quantity of nitride formed and its rate of diffusion into metal is increased by the presence of a limited amount of O_2 in the nitriding atmosphere and the presence of Fe oxide in the steel. The optimum effect is obtained if 2% O_2 is in the nitriding mixture of $N_2 + NH_3$. If preliminary oxidation of steel has not formed Fe oxide on surface, nitriding is increased, but if the slightest trace of microscopic crystals of Fe oxide is on the surface the nitriding is completely inhibited. The rate of diffusion of N has been found to depend on the concentration of dissolved oxide, the diffusivity constant increasing from 1.8×10^{-8} for deoxidized Swedish iron to 3.5×10^{-8} if the iron has been previously annealed at 1000° C. for 200 hours. 22 references. PRK (10)

New Diagrams for the Systems Pb-Tl and Pb-Tl-Cd. Correction (Neue Zustandschaubilder für die Systeme Pb-Tl und Pb-Tl-Cd. Ergänzung). Ernst Jänecke. *Zeitschrift für Metallkunde*, Vol. 27, June 1935, page 141. New experimental work of A. ölander indicates that the two-phase field between the Pb and $PbTl_2$ solid solutions should extend from 49 to 55% Pb, and that the $PbTl_2$ field should end at about 10% Pb on the Tl side. No changes are required for the Pb-Tl-Cd system. GD (10)

Superstructure Phenomena in Nickel-arsenide alloys (Überstrukturerscheinungen in Nickel-Arsen-Legierungen). F. Laves. *Fortschritte der Mineralogie, Kristallographie & Petrographie*, Vol. 19, Sect. I, 1935, pages 33-37. The mechanism of the formation of super- and "under-structures" is theoretically discussed and rotating X-ray photographs of Ni_3As_2 are presented. EF (10)

Constitution of Alloys of Copper, Aluminum and Silicon (1). Three Equilibrium Diagrams of Binary Alloys, Copper-aluminium, Aluminium-silicon and Copper-silicon systems. Chiuyo Hisatsune. *Tetsu-to-Hagane*, Vol. 21, Sept. 25, 1935, pages 726-742. In Japanese. By means of differential thermal analysis, electric resistance measurement, and microscopic examination, the diagram of the Cu-Al system was investigated, and a new diagram has been proposed. The liquidus of this system consists of 8 branches corresponding to the crystallization of phases, α, β, γ_1, ϵ_1, ϵ_2, η_1, θ and K. In this system the following nonvariant reactions take place.

Reactions	Temp. °C.	Ranges of composition (% Cu)
Melt $\rightleftarrows \alpha + \beta$,	1037	92.4 ~ 90.4
Melt $+ \beta \rightleftarrows \gamma_1$,	1020	83.7 ~ 82.0
Melt $+ \gamma_1 \rightleftarrows \epsilon_1$,	958	80.0 ~ 77.6
Melt $+ \epsilon_1 \rightleftarrows \epsilon_2$,	848	77.5 ~ 72.0
Melt $+ \epsilon_2 \rightleftarrows \eta_1$,	624	73.0 ~ 57.3
Melt $+ \eta_1 \rightleftarrows \theta$,	591	70.0 ~ 53.5
Melt $\rightleftarrows \theta + \kappa$,	548	52.5 ~ 5.7
$\beta \rightleftarrows \alpha + \gamma_2$,	572	90.3 ~ 84.5
$\gamma_1 \rightleftarrows \beta + \gamma_2$,	780	86.4 ~ 84.5
$\gamma_1 + \epsilon_1 \rightleftarrows \gamma_2$,	873	82.2 ~ 78.9
$\gamma_2 + \epsilon_1 \rightleftarrows \epsilon_2$,	850	79.8 ~ 78.5
$\gamma_2 + \epsilon_2 \rightleftarrows \delta$,	686	79.2 ~ 76.8
$\epsilon_2 \rightleftarrows \delta + \zeta_1$,	560	77.4 ~ 75.7
$\zeta_1 \rightleftarrows \delta + \zeta_2$,	530	77.8 ~ 75.2
$\epsilon_2 + \eta_1 \rightleftarrows \zeta_1$,	590	75.4 ~ 72.2
$\zeta_1 + \eta_1 \rightleftarrows \zeta_2$,	570	74.4 ~ 72.1
$\zeta_2 + \eta_1 \rightleftarrows \eta_2$,	560	73.8 ~ 72.1
$\theta + \eta_1 \rightleftarrows \eta_2$,	563	70.0 ~ 53.7

The transformation, $\gamma_1 \rightleftarrows \gamma_2$, takes place at 780° ~ 873° in the range 84.5-82.0% Cu (determined by Stockdale). ϵ and η phases undergo polymorphic transformations $\epsilon_1 \rightleftarrows \epsilon_2$ and $\eta_1 \rightleftarrows \eta_2$ respectively. The δ and ζ_1 phases are newly found and each of them forms solid solution in some range of composition. The θ phase crystallizes from the melt, and forms a solid solution in a narrow range of composition. Brief considerations on the binary diagrams of Al-Si and Cu-Si systems are given. TS (10)

BJS

The Nature of the Diffusion of Mercury on Tin. T. Alty & A. R. Clark. *Transactions Faraday Society*, Vol. 31, Apr. 1935, pages 648-659. Diffusion of clean Hg in pure Sn melted *in vacuo* was studied. The diffusion consisted of a rapid surface diffusion accompanied by a much slower volume diffusion. The surface diffusion obeyed the ordinary diffusion equations. The variation of the rate of diffusion with temperature obeyed the same laws as of absorbed films. The energy of activation of the mobile atoms on a pure Sn surface was found to be $E_0 = 1920$ Cal./g. atom. The rate of diffusion was dependent on the nature of the medium surrounding the Sn, being faster in water and slower in oil than in air. The diffusion on the surface of Sn amalgam of 8 atomic % Hg was found to have a negative temperature coefficient. PRK (10)

Note on MgZn and $MgZn_5$. L. W. McKeehan. *Zeitschrift für Kristallographie*, Vol. 91, Oct. 1935, pages 501-503. In English. Critical discussion on a previous paper by Tarchisch (See *Metals & Alloys*, Vol. 5, Aug. 1934, page MA 414, R8) and new interpretation of the structure of these intermetallic compounds. EF (10)

Solid Solutions With a Varying Number of Atoms in the Unit Cell. Gunnar Hägg. *Zeitschrift für Kristallographie*, Vol. 91, Aug. 1935, pages 114-122. In English. Discusses structural and geometric conditions for the formation of interstitial solutions, conditions of electrostatic neutrality, interstitial solutions, and electrical conductivity. EF (10)

Incomplete Atomic Arrangement in Crystals. E. J. W. Verwey. *Journal of Chemical Physics*, Vol. 3, Sept. 1935, pages 592-593. γ Fe_2O_3, γ Al_2O_3 and the oxide obtained by the electrolytic oxidation of Al (γ^1 Al_2O_3) are average structures with regard to cations. Both the γ and γ' oxides have the same oxygen lattice but there is a distinct difference in the degree of incomplete arrangement of cations. γ' Al_2O_3 and γ Al_2O_3 (Fe_2O_3) are intermediate between the amorphous state and the completely arranged state. EF (10)

Structures of Solid Solutions of Fe_2O_3 in Mn_3O_4. E. J. W. Verwey & M. G. von Bruggen. *Zeitschrift für Kristallographie*, Vol. 92, Oct. 1935, pages 136-138. In English. The investigators studied the system Mn_3O_4-Fe_2O_3. Paper deals with the crystal structure of mixtures rich in Mn. EF (10)

Equilibrium Diagrams of Tin Alloys. E. S. Hedges & C. E. Homer. *Metal Industry*, London, Vol. 47, Aug. 30, 1935, page 212. See *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 503L/3. HBG (10)

Dry Polishing Specimens for Microscopic Examination. Kenneth H. Priestley. *Foundry*, Vol. 63, Oct. 1935, pages 30-33, 72. A practical method for cast Fe. VSP (10)

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Copper-zinc Diagram (Beitrag zum Kupfer-Zink-Diagramm) J. Schramm. *Metallwirtschaft,* Vol. 14, Dec. 6, 1935, pages 995-1001; Dec. 20, 1935, pages 1047-1050. A number of disputed points in the Cu-Zn diagram were investigated by thermal and microscopic analysis of samples melted in an evacuated porcelain tube. An improved method for obtaining heating and cooling curves with a mirror galvanometer was used, which produced extremely accurate results. The transformation which takes place at about 900° C. was found to be peritectic α + melt $\rightleftarrows \beta$. The composition of these phases is $\alpha = 67.7\%$ Cu, $\beta = 63.5\%$ Cu and melt = 62.5% Cu. At 834° there is transformation among the phases β, γ, and melt which consists of solidification or melting, melt $\rightleftarrows \gamma$. The composition of β is 43.5% Cu, and γ and melt 40.25% Cu. The point H in the diagram does not correspond to the compound Cu_2Zn_3, as claimed by Bauer and Hansen, as the alloy solidifies over a temperature interval. The point W on the peritectic line UVW has the composition 1.70% Cu. The improved Cu-Zn diagram is given. 29 references. CEM (10)

On Naming the Aggregate Constituents of Steel. J. R. Vilella, G. E. Guellich & E. C. Bain. *Metal Progress,* Vol. 28, Aug. 1935, pages 28-33; *American Society for Metals, Preprint* 3, 1935, 28 pages. Micrographs are employed to illustrate and classify the modes of transformation of austenite and the tempering of martensite in C steel. A simple basis of nomenclature is set forth. "Pearlite" is applied to all lamellar structures formed directly from austenite at comparatively high sub-critical temperatures (about 950° F.). "Martensite" is applied to the constituent resulting from the transformation of austenite at low temperatures (about 300° F.). "Sorbite" is the product of tempering martensite. "Spheroidite" is suggested to designate the more coarsely spheroidized carbide structure. "Troostite" is not used in their nomenclature and a constituent resulting from the transformation of austenite at temperatures between 1000° and 300° F. is not named. Its hardness and coalescence depend upon the temperature of transformation and it is tougher than tempered martensite of the same hardness. It seldom occurs in commercial steel. WLC (10)

A Study of the Molybdenum-carbon System. W. P. Sykes, K. R. Van Horn & C. M. Tucker. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 173-189. Includes discussion. See *Metals & Alloys.* Vol. 7, Jan. 1936, page MA 26R/2. (10)

Solubility of Oxygen in Solid Cobalt, and the Upper Transformation Point of the Metal. A. U. Seybolt & C. H. Mathewson. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117. 1935, pages 156-172. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 26L/9. (10)

Origin and Growth of Graphite Nuclei in Solid and Liquid Iron Solutions. H. A. Schwartz & Wolfram Ruff. *Metals Technology, American Institute Mining & Metallurgical Engineers Technical Publication* No. 655, Dec. 1935, 17 pages. The number of nuclei capable of growing into graphite aggregates was determined by observing the number of such aggregates per unit volume of alloy. It was found that the number of nuclei in white Fe capable of growth is a function of the temperature at which germination takes place and also of various melting conditions, including composition of furnace atmosphere. The number of nuclei capable of growth during freezing presents a more difficult problem and was not completely investigated. Some variables of melting practice effective in altering nucleus number in white Fe are shown to have similar effects in gray Fe. A means was devised for evaluating the degree of "sprawliness" of secondary graphite, and a means suggested, though less successful, may be of some value in the same connection for primary graphite. Various theories of nucleation receive attention. 24 references. JLG (10)

Lattice Constants of Five Elements Possessing Hexagonal Structure. E. A. Owen, Llewelyn Pickup & I. O. Roberts. *Zeitschrift für Kristallographie,* Vol. 91, July 1935, pages 70-76. In English. Reports on precision measurements on the following hexagonal elements: Zn, Mg, Ru, Os, and Be. The methods of calculating the parameters are fully described. Purity of metals utilized and previous determinations are given. EF (10)

Crystal Structure of CdSb. Arne Ölander. *Zeitschrift für Kristallographie,* Vol. 91, Sept. 1935, pages 243-247. In English. Rotating-crystal photographs and powder photographs of compound CdSb lead to the following dimensions of the unit cell a = 8.492 A.U.; b = 8.320 A.U.; c = 6.390 A.U. There are 16 atoms per unit cell. The structure of CdSb is probably a severely deformed NaCl type. EF (10)

X-ray Study of Copper-silver Alloys. E. A. Owen & Joseph Rogers. *Metal Industry,* London, Vol. 47, Sept. 13, 1935, page 273. Abstract. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 332R/5. HBG (10)

Precision Determination of Lattice Constants. Eric R. Jette & Frank Foote. *Journal of Chemical Physics,* Vol. 3, Sept. 1935, pages 605-616. In Part I the theoretical and experimental conditions which must be satisfied in order to determine lattice constants with a precision of a few parts per 100,000 are discussed with particular application to the symmetrical focussing type of camera. Cohen's method of calculation of lattice constants *(Revue of Scientific Instruments,* Vol. 6, 1935, pages 68-74) for the elimination of "drift" and experimental errors is applied. Methods are developed for the evaluation of standard errors and fiduciary limits of results from a single film and from a set of films. The usefulness of X-ray targets made of alloys rather than pure metals for the purpose of securing a larger number and better distribution of lines is indicated. The influence of the number and Miller indices of diffraction lines on the values of lattice constants in non-cubic systems is shown. The importance of the methods of sample preparation for precision work is emphasized. In Part II precision measurements (in A.U.) on the following 14 metallic elements of high degree of purity are reported: Al: a = 4.04139; Ni: a = 3.51684; Ag: a = 4.07787; Au: a = 4.07042; Si: a = 5.41982; Fe: a = 2.86046; Mo: a = 3.14103; W: a = 3.15837; Mg: A = 3.20300, c = 5.2002; Zn: a = 2.65949, c = 4.93685; Cd: a = 2.97311, c = 5.60694; Sb: a = 4.29957, c = 11.2516; Bi: a = 4.53726, c = 11.8381; Sn: a = 5.81950, c = 3.17500. The fiduciary limits of these lattice constants vary between 2 and 7 parts per hundred thousand and are so chosen that the probability of the correct value lying between the stated limits is 19 out of 20. The densities (25° C.) calculated from the X-ray data are compared with the density values given by the International Critical Tables. EF (10)

X-ray Study of Iron-nickel Alloys. Eric R. Jette & Frank Foote. *Metals Technology,* Jan. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 670, 14 pages. Alloys studied were vacuum melted from carbonyl Fe and electrolytic Ni. Lattice constants of the γ phase were determined over the range 25 to 100% Ni with high precision. Positive deviations from the additive rule of exceptional magnitude were observed. The maximum lattice constant was found at 39 at. % Ni. From 100 to 43 at. % Ni the lattice constant varied as:

$$a_o = 3.64033 - 0.0012379 \text{ (at. \% Ni)}$$

It decreases sharply from its maximum value and from 0 to 20% Ni it extrapolates in a linear manner to Ohman's value for pure γ Fe. The α phase up to 5% Ni was also studied and a marked positive deviation found. A limited number of experiments were made to determine the 2-phase region, but the results give highly tentative limits. No evidence of compound formation or superstructures was found. 18 references. JLG (10)

The Lattice Constants of Beryllium. E. A. Owen & Llewelyn Pickup. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Dec. 1935, pages 1155-1158. On account of discrepancies of previous determinations, a redetermination of the lattice constants of Be was made with the result that $a_o = 2.2810_5$ A.U. and $c_o = 3.5571_4$ A.U., therefore $c_o/a_o = 1.5682$. The source of previous errors is discussed. Ha (10)

Crystal Structure of $AuBe_5$ and $PdBe_5$ and Its Relation to the Cubic AB_2 Structure (Die Kristallstruktur des $AuBe_5$ und $PdBe_5$ und ihre Beziehung zur kubischen AB_2-Struktur) Lore Misch. *Metallwirtschaft,* Vol. 14, Nov. 8, 1935, pages 897-899. The intermetallic compounds $AuBe_5$ and $PdBe_5$ were prepared by melting in an electric furnace, and were examined by X-rays. Both have a face-centered-cubic lattice with 24 atoms in the elementary cell. The lattice constant for $AuBe_5$ is 6.085 A.U. and for $PdBe_5$ 5.982 A.U. The lattice structure is not quite the same as the typical cubic AB_2 structure, such as $MgCu_2$, but corresponds to that of ZnS. CEM (10)

Arsenic-Lead Alloys (Die Arsen-Bleilegierungen) O. Bauer & W. Tonn. *Zeitschrift für Metallkunde,* Vol. 27, Aug. 1935, pages 183-187. The equilibrium diagram to 30% As was redetermined by cooling curves taken on 100 gram melts; a eutectic at 2.6% As and 290° was found. Powder photograms show that the phase separating beyond the eutectic is nearly pure As. Hardness measurements on alloys homogenized at 280° and then quenched from various temperatures indicate a solubility of 0.045 to 0.05% As at the eutectic temperature, which decreases to less than 0.01% at 20°. The As-rich solid solution is appreciably harder. The hardness of alloys quenched from 280° diminished markedly at 20° in six weeks. The specific gravity decreases linearly from that of pure Pb (11.3) to 10.778 at 5% As. In both chill cast and slowly cooled samples no segregation was found up to 2.5% As, but with greater additions As tends to concentrate at the top. Piping was a minimum at the eutectic composition. Repeated remelting at 550° showed small losses of As. Shrinkage was diminished by additions of up to 0.1% As. Corrosion in distilled water containing 70 mg. CO_2/l. was inhibited by the formation of a protective coating which was not formed if only 2 mg. CO_2/l. was present, the presence of As having no apparent effect. These As alloys seem to have no advantage over the usual bearing and type metals. GD (10)

X-ray Analysis of Lithium-zinc Alloys (Röntgenanalyse der Lithium-Zink Legierungen) E. Zintl & A. Schneider. *Zeitschrift für Elektrochemie,* Vol. 41, Nov. 1935, pages 764-767. Debye-Scherrer photograms were made of Li-Zn alloys at room temperature with filtered Cu-K radiation. Among the interference lines of the 1.9 at. % Li alloy were those of Zn solid solution and of β' phase. At 10.5 at. % Li, only β' interferences appear. At 28 % Li, only γ' phase exists. At 32 and 39 % Li, lines of $LiZn_2$ are relatively weak, fading into those of γ' and δ' phases, respectively. δ'-phase exists at 42, 46, and 49 % Li. The interference lines of LiZn appear with increasing intensity for these latter alloys. According to the equilibrium diagram the alloys above 50 % Li should contain free Li but this could not be proved because of the low scattering power of the Li atom. Interference lines of LiZn are found up to 80 % Li. From powder photograms of the 10.5 % Li alloy the structure of the β'-phase was found to be hexagonal: c/a = 1.57, a = 2.782 and c = 4.385 A.U. There are 2 atoms per unit cell. The atomic species are arranged statistically. This is checked by intensity measurements and calculations of lattice parameter using Goldschmidt's atomic-radii values and assuming a coordination number of 12. The structure of the phase at 28 % Li is hexagonal, c/a = 0.57, a = 4.362 and c = 2.510 A.U. These dimensions refer to a pseudo-cell in which the 2 Zn atoms are at 000 and 1/3, 2/3, 1/2. Line intensities indicate the true unit cell to be 4 times larger than this pseudo-cell. For the true unit cell then either $c' = 4c$, and $a' = a$, or $c' = c$ and $a' = 2a$. HAS (10)

Structure of Platinum-Thallium Alloys (Struktur der Platin-Thallium Legierungen) E. Zintl & A. Harder. *Zeitschrift für Elektrochemie,* Vol. 41, Nov. 1935, pages 767-771. In this system only one intermediate type of crystal, PtTl occurs. Solubility of Pt in Tl could not be detected from the powder diagrams. Tl dissolves in Pt, expanding the lattice by 1.5%. Alloys above 50 atomic % Tl contain free Tl. Rotating crystal and Weisenberg goniometer photograms were made of single crystals of PtTl. Data from these and from powder photograms permitted a determination of the structure: hexagonal, a = 5.605 A.U., c = 4.639 A.U. There are 3 atoms of Pt and 3 of Tl per cell. The position of the 6 atoms (each of about the same scattering power) are 000, ½ ½ 0, ½ 00, 0½0, 1/3 2/3 1/2, 2/3 1/3 1/2. Interatomic distances are: atoms at 000 have 6 neighbors at 2.80 A.U.; atoms at ½00, 0½0, ½½0 have 6 neighbors at 2.80 A.U. and 4 neighbors at 2.83 A.U.; and atoms at 1/3 2/3 1/2 and 2/3 1/3 1/2 have 6 neighbors at 2.83 A.U. Pt does not form with Tl any structure of the nickel-arsenide type. HAS (10)

Formation of Solid Solution with Tin Monoxide (Über Mischkristallbildung mit Zinnmonoxyd). Erich Hayek. *Sitzungsberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse, Abt. II b, Chemie,* Vol. 144, No. 7, 1935, pages 329-332. Solid solutions of SnO with oxides of other bivalent metals were prepared. Whereas solid solutions with Pb, Mn, Fe, Zn, Cd, and Ca could be obtained, Co, Ni, Mg, Sr, and Ba did not enter the SnO lattice. The preparations made exhibit characteristic colors. Their homogeneity was proved by X-rays. EF (10)

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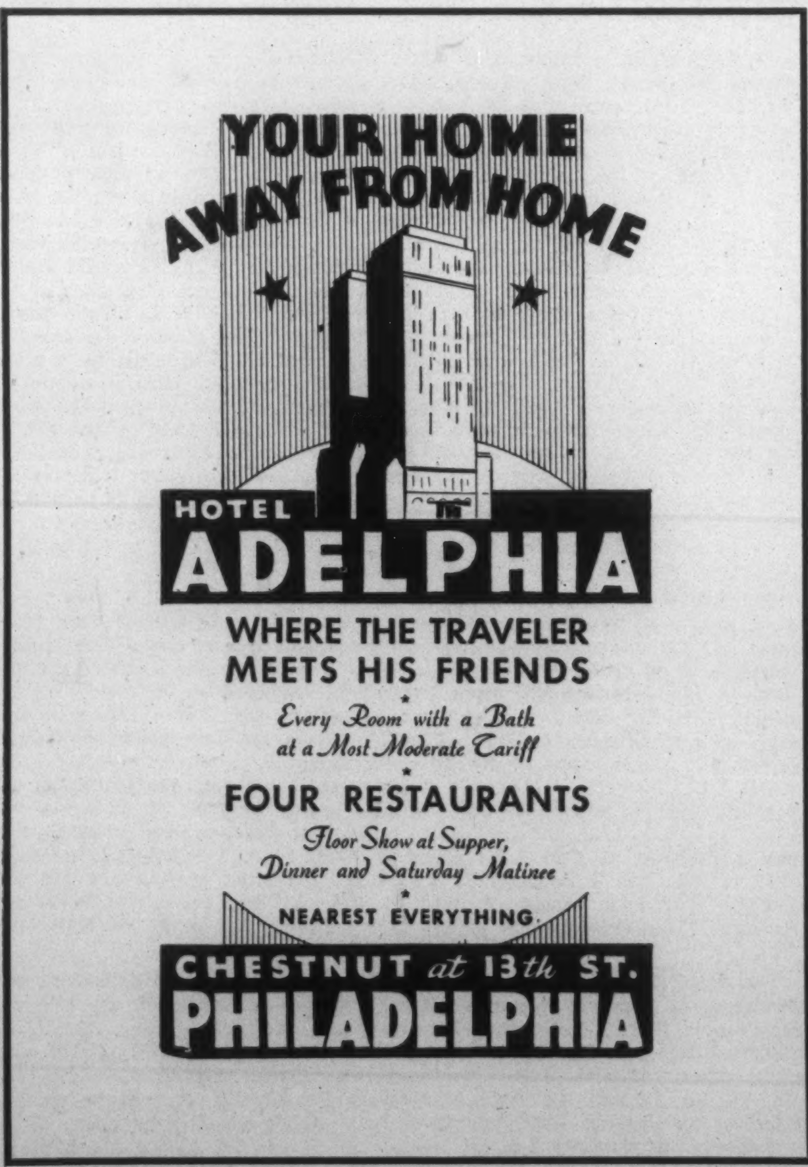

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11. PROPERTIES OF METALS AND ALLOYS

The Structure of Metal Surfaces. L. L. Bircumshaw. *Metal Treatment,* Vol. 1, Autumn 1935, pages 149-151. A review of recent work. Electron diffraction methods show oxide films to have a structure oriented in respect to the metal surface, and have verified the existence of the amorphous Beilby layer on a polished surface. 8 references. JCC (11)

Dynamic Elasticity of Metals (Elasticité dynamique des métaux) A. Leblanc. *Métaux,* Vol. 10, Sept. 1935, pages 209-213. The elastic deformation which is produced in a metal subjected to dynamic forces is given the name of dynamic elasticity. (1) Elastic deformation by impact is given by $\epsilon = 1000\ E^2/2M = 500E^2/M$. Where ϵ is the absorption capacity of impact work per cubic decimeter of metal, M is the coefficient of elasticity longitudinal of the metal. E is the elastic limit of the metal, all terms expressed in kg./mm.^{2} GTM (11)

The Vapor Pressures of Metals (Ueber Metalldampfdrucke) A. Eucken. *Metallwirtschaft,* Vol. 15, Jan. 10, 1936, pages 27-32; Jan. 17, 1936, pages 63-68. A critical review of existing data, made necessary by the many discrepancies recorded. A consideration of experimental methods indicates that direct manometric measurements under equilibrium conditions are valid for temperatures below 1400° C. The dynamic methods all introduce an uncertain error when reduced to equilibrium conditions. Methods depending upon the determination of the boiling point of the metal for various external pressures are all uncertain due to difficulty in measuring the boiling temperature. Kinetic methods such as that of Knudsen which measures the rate of effusion through a jet into a vacuum, or Langmuir's observations of rates of vaporization from heated wires are generally better. Even when data are correct over a small range, direct extrapolation is dangerous. However, by applying thermodynamic equations combined with data on specific heats and heats of vaporization, better vapor pressure curves may be drawn. The data required for these equations are discussed critically and the best values tabulated for 29 important metals, along with the temperature ranges over which the formula may be applied safely. GD (11)

A Comparison of Corrosion-Resistant Steel (18:8) and Aluminum Alloy (24ST). J. E. Sullivan. *National Advisory Committee for Aeronautics, Technical Note* No. 560, Mar. 1936, 11 pages mimeographed. The 2 metals chiefly considered for aircraft construction are compared as to suitability for various types of applications. Each has advantages in certain types of service, but the author considers that 18:8, given the desired properties by cold-working, is not so uniform, nor its properties so capable of accurate determination, as the Al alloy. High tensile steel, given its properties by heat-treatment rather than by cold working is considered to have an advantage over 18:8 even though it may require protection against corrosion. For tie-rods, for example, heat-treated 16% Cr, 1% Ni is considered to have possibilities. The vastly superior impact resistance of 18:8 shown on a notched bar test is not considered conclusive as regards the engineering usefulness, since the ability to resist injury when subjected to a suddenly applied load at the elastic range is of greater importance than the work required for actual fracture. Stainless steel ribs in airplanes were found considerably corroded by salt water in 182 hours of flight time. In inaccessible locations anodically treated Al, painted, is held to be more satisfactory in corrosion-resistance than stainless. HWG (11)

On the Theory of Surface Tension of Liquid Metals. D. V. Gogate & Duleh Sinha Kothari. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 20, Dec. 1935, pages 1136-1144. The relation of surface tension and total surface energy was theoretically investigated and an electron theory of surface tension of liquid metals is developed. The agreement between observed and calculated values is satisfactory. The surface tension of liquid metals is very much greater than that of other substances; numerical values are given in tables and curves. Ha (11)

Gases in Metals. C. J. Smithells. *Metal Treatment,* Vol. 1, Winter 1935, pages 165-171. Stresses the relation between adsorption, diffusion, and solubility phenomena exhibited by gases in metals. Present knowledge of adsorption and diffusion is well summarized, typical curves being included and diffusion factors for all systems so far investigated tabulated. 6 references. JCC (11)

Increase of Deformability and Decrease of Cleavage with Rising Temperatures (Zum Wachsen der Verformbarkeit und zum Abnehem der Spaltbarkeit mit zunehmender Temperatur) G. Tammann & W. Müller. *Zeitschrift für Metallkunde,* Vol. 27, Aug. 1935, pages 187-189. The general applicability of the title is demonstrated by means of pressure figures and scratches on cleavage faces of Zn, Bi, and Sb, and on picked orientations of α Fe. It is shown that the transition is quite sharp, cleavage disappearing at about 20° in Zn, 150° in Bi, and 300° in Sb. These conclusions are checked by bend tests on Sb and Bi at various temperatures. The pressure figures on Fe confirm cleavage on cube planes. GD (11)

Modulus of Elasticity of Materials for Small Stresses. R. H. Evans & R. H. Wood. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, Jan. 1936, pages 65-80. In order to elucidate the mechanism of creep experiments were made concerning the elasticity of metals and building materials for small stresses. The tests show that as the range of the applied stress is decreased the modulus of elasticity (Young's) increases which seems to indicate that the strain approaches that due to the elastic distortion of the crystals. A theory is developed which gives an explanation for the rapid changes in the value of the modulus near zero stress in both tension and compression. The tests were made with a cast Fe column and are described, together with the instruments used, in detail. 11 references. Ha (11)

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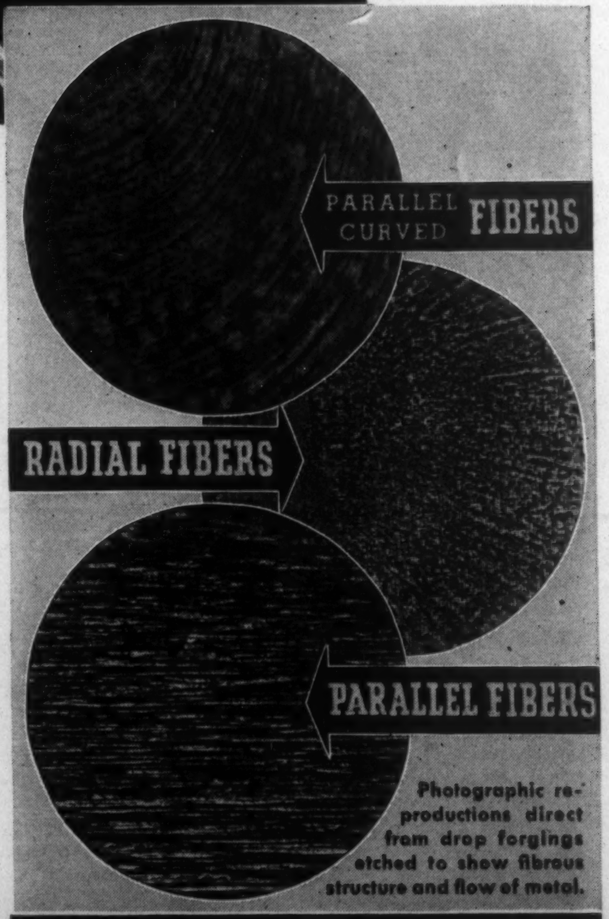

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■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Committee for Aluminum Conductivity Standards (Ausschuss für Aluminiumleitungsnormen) *Zeitschrift für Metallkunde,* Vol. 27, Oct. 1935, page 250. Miscellaneous standards for hard drawn and annealed Al wire. FNR (11a)

Gallium and Its Compounds. *Chemical Trade Journal & Chemical Engineer,* Vol. 96, Feb. 21, 1935, page 131. From *Bulletin of the Electrochemical Society.* Summary of method of production, properties of the metal, salts, and alloys. MS (11a)

Endurance Limit of Black-Heart Malleable Iron. E. G. MAHIN & J. W. HAMILTON. *Transactions American Foundrymen's Association,* Vol. 6, Dec. 1935, pages 41-47. A blackheart malleable Fe was used in this study with the composition: Si 1.00%, C 2.44%, Mn 0.31%, S 0.072%, and P 0.168%. A determination of the endurance limit was made. Specimens were of the Farmer type, tested in a transverse rotating beam machine. An endurance limit of slightly higher than 30,500 lbs./in.^{2} was found which is somewhat higher than the few tests already on record. A brief discussion of the form of, and the possible influence of, graphite nodules is included. CEJ (11a)

Carbides of Refractory Metals. G. A. MEERSON. *Redkie Metallui,* Vol. 4, July-Aug. 1935, pages 6-20. In Russian. A mixture of TiO_2 and C was heated to a temperature of 1200° to 3000° C. The TiC obtained had a cubic lattice with a parameter of 4.26-4.31 A.U. In most cases the combined C content was much less than the theoretical; only at a very high temperature was the theoretical approached. The TiC was mixed with WC and Co, pressed, and sintered at 1500° C. The alloy obtained had a hardness of 87-90 Rockwell "C" and gave good results in cutting tests. Mixtures of W and Ti carbides were also prepared by heating finely ground W, TiO_2, and C. TiC forms readily and at a lower temperature in the presence of W. HWR (11a)

The Magnesium-copper Alloys. Part V.—The Copper-rich Alloys. W. R. D. JONES. *Journal Institute of Metals,* Vol. 58, Jan. 1936, pages 41-48 (Advance Copy No. 723). Alloys containing as much as 6% Mg were made. Great difficulty was encountered in obtaining good castings because the Mg tended to oxidize and the dross to remain with the solid alloy. Up to 2 or 3% Mg increases the strength of Cu but reduces ductility to a low value. At 4.25% Mg alloys are very brittle and break in the tensile test with no elongation. Most of the alloys cracked when rolled, but alloys with 0.71 and 1.42% Mg were rolled into rods. There is not much possibility that the Cu-rich Cu-Mg alloys will be useful. JLG (11a)

Transversely Loaded Framework Members. N. J. HOFF. *Journal Royal Aeronautical Society,* Vol. 39, Aug. 1935, pages 718-749. Develops mathematical formulae for computing the strength of aircraft framework, avoiding the usual assumption that members are freely pinned. Tests made on experimental constructions corroborated theoretical deductions. FPP (11a)

Metals Used in Die Casting. CHAS. H. HUGHES. *Machinery,* N. Y., Vol. 42, Mar. 1936, pages 446-449. Composition and characteristics of alloys in general use for the production of die castings are described. Al die casting alloys possess the advantage of comparatively high tensile strength, light weight, resistance to corrosion, ability to take a good polish and to hold it under normal atmospheric conditions. Cu base alloys have superior qualities as regards strength, impact value, and elongation, and are not affected by many chemicals. Mg base alloys are about 2/3 as heavy as Al and 1/5 as heavy as brass. Sn lends itself particularly well to die casting because of its low melting point; Sn alloys are used for die casting soda-fountain appliances, parts of dairy machinery and articles that must be immune to action of acids from food products. Ha (11a)

Contribution to the Surface Chemistry of Tin (Beiträge zur Oberflächenchemie des Zinns) ARTUR KUTZELNIGG. *Zeitschrift für Metallkunde,* Vol. 28, Jan. 1936, page 5. The rate of attack of Sn by $FeCl_3$ solution and HCl is markedly increased by the presence in the metal of as little as 0.01% Sb, while considerable protection against attack is afforded by small quantities of alloyed Bi. The relatively great resistance of high purity Sn to attack is attributed to the formation of a protective oxide layer. FNR (11a)

The Differing Behavior of Cast and Recrystallized Single Crystals of Aluminum of Various Degrees of Purity (Über das verschiedenartige Verhalten von Schmelzfluss und Rekristallisations-Einkristallen aus Aluminium verschiedenen Reinheitsgrades) F. GISEN. *Zeitschrift für Metallkunde,* Vol. 27, Nov. 1935, pages 256-261. Recrystallized single crystals of Al are shown to have a critical shear strength which decreases with increasing purity of the metal, while cast single crystals exhibit a gradually increasing plastic response to increasing shearing stresses. Cast crystals were made from 99.5, 99.8, 99.87 and 99.998% Al by the progressive freezing method and some of the crystals so made were subsequently caused to recrystallize into new single crystals by the strain-annealing method. The specimens were loaded in tension and the resulting decreases in diameter were plotted against the load, giving curves composed of 2 straight lines meeting at a sharp critical point in the case of the recrystallized material and single curves of gradually decreasing slope in that of the cast crystals. An effort is made to explain this difference in behavior by the demonstration of the existence of a mosaic structure in the recrystallized specimens. The plastic response to shearing stresses occurs at about 75 g./mm.^{2} in the 99.998% Al recrystallized material and below 20 g./mm.^{2} in similar cast crystals. 27 references. FNR (11a)

The Hydrogen Peroxide Theory of Electrolytic Oxidation and the Influence of the Electrode Surface on Anodic Processes. S. GLASSTONE & A. HICKLING. *Transactions Faraday Society,* Vol. 31, Dec. 1935, pages 1656-1660. Anodic overvoltages were determined on Pt, Au, PbO_2, C and Ni. Overvoltages cannot be correlated in any simple manner with the efficiencies in the oxidation of acetate, thiosulphate and sulphite ions. It is shown that the formation of H_2O_2 in solutions by the union of hydroxyl radicals is not improbable. No one mechanism is likely to account for all the various types of anodic oxidation reactions. 16 references. PRK (11a)

■ 11b. Ferrous ■

V. V. KENDALL, SECTION EDITOR

Construction Steels (Les aciers de construction) L. PERSOZ. *Métaux,* Vol. 10, Oct. 1935, pages 216-242. The present study, of which this is the first part, contains the fundamentals of construction steels. It is a comprehensive survey of physical testing, constitution of steels, heat treatments and classifications of steels. All the common physical testing and examination methods employed in control of construction steels are discussed. GTM (11b)

✓ **Recent Uses of Molybdenum in Ferrous Metallurgy (Les récentes applications du molybdène en sidérurgie)** JEAN COURNOT. *Revue de Métallurgie,* Vol. 32, Nov. 1935, pages 562-576. Long list of steels containing Mo including the most recent types supplemented with detailed description and physical properties. Use of Mo in steel casting and in cast irons fully described. JDG (11b)

Nitrogen in Electric Steel. N. CHUIKO. *Domez,* No. 8, 1935, pages 27-38. In Russian. A comprehensive survey of the literature data on the subject and the theoretical considerations regarding the dissociation of N and its solubility in the metal developed by the author are given. A study of 7 heats made in different furnaces run at a different rate and having dissimilar arcs showed that N increases in the metal in direct proportion to the time of heat, other conditions being equal, up to its saturation point, 0.03-0.04% N. A more rapid N absorption could be observed when the surface of the bath was bare. Absorption speed increases with the tension of the arc and specific capacity of the furnace. The type of the arc, stationary or rotating, does not have any effect. (11b)

Oxygen in Copper. H. J. MILLER. *Metal Treatment,* Vol. 1, Winter 1935, pages 191-194, 201. The amount of O in molten Cu determines the amount of H dissolved and thus the soundness or "pitch" of the resulting ingots. The effect of O content on annealing temperature, tensile properties after varying degrees of reduction, fatigue endurance, and susceptibility to "gassing" is reviewed. 22 references. JCC (11b)

Steel, Report of Committee A-1. H. H. MORGAN, Chairman. *Proceedings American Society for Testing Materials,* Vol. 35, Part I, 1935, pages 60-69. Progress report on Tentative and Standard Specifications and revisions. VVK (11b)

✓ **Copper-Molybdenum Steel.** *Industry & Welding,* Vol. 8, Jan. 1936, pages 57-59. Cu-Mo steel as corrosion-resisting material is described in general. The average composition is usually: C 0.045%, Mn 0.45%, S 0.013%, P 0.014%, Si 0.01%, Cu 0.3%, Mo 0.05%. Mo forms so solid a solution with ferrite that it is impossible to detect its presence by micrographic methods; it gives a fine, close-grained structure to the Cu-Mo steel, and increases resistance to corrosion, ductility and toughness, impact strength, resistance to oxidation at elevated temperatures, and the ratio of elastic limit to tensile strength is very high. Corrosion and physical tests are described. Ha (11b)

Iron-Carbon-Beryllium Alloys (Alliages Fer-Carbone-Glucinium) M. BALLAY. *Usine,* Vol. 44, Dec. 19, 1935, page 27. Fe alloys with 3-4.45% C and 0-4% Be (besides 0.25% Mn, 0.25% Si, 0.02% S, 0.05% P) were studied. Solidification took place in the metastable cementite system without graphite formation. With Be contents of 1.2-1.7%, the apparent quantity of cementite bound to the existence of complex carbides of Fe and Be was increased quite considerably. A Be carbide of the form Be_2C was found at higher Be contents. The hardness after quenching from 950° C. depends on the Be content; compared with the hardness as cast the following figures were found:

		hardness (Vickers 50 kg.)		
% C	% Be	after casting	after quenching at 950° C.	Structure of cast state
3.15	0	407	608	pearlite + cementite
3.08	0.31	426	657	pearlite + cementite + little graphite
3.16	0.65	325	604	pearlite + cementite + graphite
3.14	1.43	740	906	pearlite + complex cementite
3.20	2.15	543	849	pearlite + complex cementite + little Be_2C
3.15	2.80	493	836	pearlite + secondary cementite + Be_2C
3.30	3.88	443	691	pearlite + Be_2C + very little secondary cementite

A maximum hardness of 935 was found for an alloy with 4.32% C and 1.7% Be. The A_c transformation point of Fe-C alloys is little influenced by addition of Be. Ha (11b)

Graphitization of Cast Iron (Note au Sujet de la Graphitisation des Fontes) A. LE THOMAS. *Revue Universelle des Mines,* Vol. 11, Dec. 1935, pages 553-554. Tests made by the author agree with the results published previously by Portevin (*Comptes Rendus,* Vol. 189, 1929, page 759); 300° C. must be assumed as the practical temperature below which castings do not undergo any further measurable change by slow graphitization. 11 references. Ha (11b)

B3S ✓ **Heat Resistant Cast Irons (Fontes pour Applications a Chaud)** R. LEMOINE. *Bulletin de l'Association Technique de Fonderie,* Vol. 9, Oct. 1935, pages 339-340. Paper presented at the General Meeting of French Foundrymen. Growth of cast Fe is caused by graphitization, formation of fissures, and formation of compounds. Heat resistant cast irons are divided into 2 classes, pearlitic and non-pearlitic. The pearlitic class includes: (a) cast Fe with Si content as low as possible for gray cast Fe; (b) low Si cast Fe which is gray because of heated molds and slow cooling; (c) low Si irons cast white and annealed; (d) low C cast Fe with low Cr content; (e) cast Fe which would normally be white, but is cast gray because of stream or ladle additions. The non-pearlitic class consists of: (a) white cast Fe with low Si and high Cr contents; (b) ferritic Fe with high Si or high Al content; (c) cast Fe of stable austenitic structure; (d) solid solution irons with very high Cr content. WHS (11b)

SOME NOTES ON BETHLEHEM ALLOY STEELS

VII-Silico-Manganese Steels

Silicon is a powerful deoxidizing agent, and manganese to a lesser degree behaves in the same manner. Manganese also exerts beneficial effects on the physical properties of heat-treated steel. Silicon increases strength. The balanced combination of both elements produces a steel of unusually high strength and one with sufficient ductility for the services to which it is adapted.

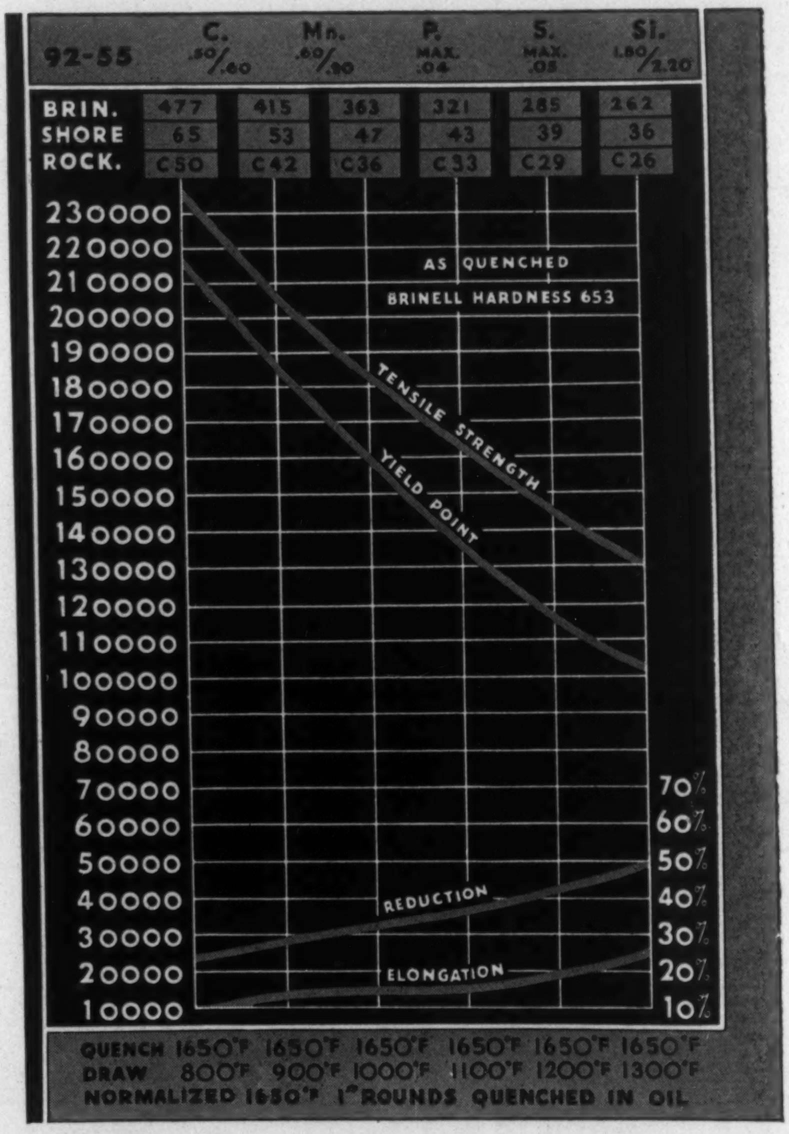
The silico-manganese steels are grouped under the S. A. E. 92xx Series and contain about 2.00 per cent silicon and 0.80 per cent manganese. The carbon content varies in accepted ranges from 0.48 to 0.67 per cent, depending on the application and the heat-treatment requirements.

One of the most important applications of silico-manganese steels is for springs, both in the railway and automotive fields. Bethlehem pioneered the application of silico-manganese steel to springs more than 25 years ago. In the years that have elapsed since its introduction, continuous effort has been put forth to bring out the full latent possibilities of this steel as spring material.

A spring dissipates energy, mainly through internal strain friction. If this internal strain is within the elastic limit of the material, it will ordinarily not cause fatigue—provided there is sufficient time between flexures to permit the metal to recover. Severe stresses, though within the elastic limit, if occurring in quick succession are to some extent cumulative in their effects on the steel. Fatigue may follow. Proper methods of manufacture and effective heat treatment insure maximum endurance.

As Bethlehem makes silico-manganese steels for springs, the surface is carefully processed at all stages to avoid imperfections that might provide a starting place for fatigue. Special care is exercised in rolling to obtain cold-shearing qualities and, in the case of flat sections, punching and trimming qualities. The uniformity of the structure is controlled with extreme accuracy to insure both high inherent fatigue resistance and uniform heat-treating characteristics.

Although silico-manganese steels have their principal use for springs, they have also been successfully used for chisels, drift pins, punches, digging bars, shear blades, mine bits and pulp-beater bars. They respond readily to oil quenching and, when drawn to the correct temperature, possess, in addition to the strength required for springs, excellent toughness and resistance to shock.



★ *Physical properties of S. A. E. 92-55, a silico-manganese spring steel.* ★

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

GENERAL OFFICES: BETHLEHEM, PA.

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

have

Relation of Temperature to Indentation Hardness of Metals. II. (Die Temperaturabhängigkeit der Kegeldruckhärte der Metalle. II). J. Engl & J. Fölmer. *Zeitschrift für Physik*, Vol. 98, Feb. 3, 1936, pages 702-708. Curves are drawn to show the relation of indentation hardness of W and Mo up to 1900° C. and for a series of Cu-Ni alloys up to their melting points with the following compositions:—pure Cu, 10% Ni, 20% Ni, 45% Ni, 67% Ni and 100% Ni. FHC (12)

Short-Time Tensile Tests at 850° F. of the 0.35 Per Cent Carbon Steel Material K 20. H. J. Kerr. *Transactions American Society of Mechanical Engineers*, Vol. 58, Feb. 1936, pages 97-101. A report is made on tests with K 20 in accordance with the short-time high-temperature test code, A.S.T.M. specification E 21-34T. It can be stated that temperature differences are the principal causes of variations in ultimate strength. The influence which temperature and setting of specimen in holders have on the tests is discussed and determined. Ha (12)

have

Heat Resisting Cast Irons. E. Morgan. *Proceedings Institute of British Foundrymen*, Vol. 26, 1932-1933, pages 148-174. See *Metals & Alloys*, Vol. 5, Apr. 1934, page MA 160. CEJ (12)

Expansion of Light Metals for the Pistons of Combustion Motors at the Operating Temperatures (Dilatazione delle Leghe leggiere per Stantuffi di Motori a Scoppio alle Temperature di Funzionamento) C. A. Maresca. *Industria Meccanica*, Vol. 18, Jan. 1936, pages 1-5. The expansion coefficients of 10 of the most used Al alloys were measured and are given, together with the nature of heat treatment and Brinell hardness of the material, in a table for the interval of +20° to +275° C. A modified method of measuring the temperatures with the Chevenard instrument is described. Ha (12)

have

Notched-Bar Toughness of Fusion Welds at Low and High Temperatures. Wilhelm Kleinefenn. *Iron & Steel Institute, Carnegie Scholarship Memoirs*, Vol. 24, 1935, pages 87-102. The position of the steep portion of an impact-temperature curve relative to temperature is taken as a criterion for indicating whether or not the welds are satisfactory under the conditions of the tests. The steep portion of this curve is lowest for welds made using covered electrodes, and highest for welds made using bare-wire electrodes. Normalizing for half an hour at 920° C. gives rise to a movement of the steep portion of the curve toward lower temperatures in the case of autogenous welded specimens but has little effect on the electrically welded ones. By use of alloyed welding rods the notch toughness of welds is increased, particularly at high temperatures. Specimens welded by the autogenous method or by the electric arc using bare-wire electrodes show a very coarse grain when fractured. If, however, covered electrodes are used the fractured specimens have a much finer grain. Better notch toughness values are obtained by use of covered alloy electrodes in the case of autogenous and direct current welding. This, the author believes, is due to the fact that Ni reduces the amount of gas absorption in the weld. Bare wire electrodes containing Ni do not have this advantage in the case of direct current welding because the adsorption of gas is too great. Unalloyed electrodes used in the tests contained 0.08% to 0.10% C and alloyed electrodes 0.05% to 0.15% C with 2% to 3.5% Ni. The parent metal welded in the tests was a commercial steel. 16 references. CW (12)

The Properties of Metals at Elevated Temperatures. C. L. Clark & A. E. White. *Engineering Research Bulletin* No. 27, *University of Michigan*, March 1936, 100 pages. Price $1.00.

Investigations carried on for commercial interests and previously reported in a score of papers by these authors are here collected into a connected running account. The pamphlet is unique in its field in that it cites no literature and includes no data from sources other than the work of the authors. Even the University of Michigan work on torsional creep, carried out in another department, is excluded. The question of variation of methods, used by different investigators, therefore, does not arise, but with such a title it seems odd that no reference was made to the experimental work of the Bureau of Standards, of the National Physical Laboratory, of Norton for Babcock and Wilcox at Massachusetts Institute of Technology, of the General Electric Company, the Midvale Company, or the Joint Committee on the Effect of Temperature on the Properties of Metals.

Though the authors have thus chosen to consider only their own data, there is a lot of data, used more to establish the general principles the authors desire to stress, than for its own sake, and in presentation of these data, much pertinent information that the reader needs has not been included so that the originals need to be consulted. This pamphlet is thus chiefly valuable for the general picture it presents. While it is chiefly concerned with creep, it brings out clearly that creep resistance is only one of several properties that the engineer must evaluate in selecting a metal for high temperature service.

One oddity in a presentation normally conscientious and scientific is the presentation of one plot of data with the alloys described by trade names only, although in a previous discussion (*Metal Progress*, Oct. 1934, page 54), some of the same data were published with some information as to composition. H. W. Gillett (12) -B-

13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

A Laboratory Study of the Atmospheric Corrosion of Metals. Part II—Iron: The Primary Oxide Film. Part III—The Secondary Product or Rust (Influence of Sulphur Dioxide, Carbon Dioxide, and Suspended Particles on the Rusting of Iron) W. H. J. Vernon. *Transactions Faraday Society*, Vol. 31, Dec. 1935, pages 1668-1700. Marked differences in the properties of the oxide film on Fe were observed according to whether the film was produced above or below a critical temperature of very nearly 200° C. At a higher temperature a parabolic relation between oxidation and time was closely followed. The colors produced are consistent with interference of light in a continuous transparent sheath. At temperatures below the transition point, there is a marked deviation from the quadratic parabola. The relationship between film thickness and color is no longer obtained. The ill-defined colors that ultimately appear suggest diffraction in a granular type of film. In purified air of high relative humidity, the rusting of mild steel is greatly reduced owing to the strengthening of the primary film in the early stages if the higher humidities are approached gradually from zero. In the presence of traces of SO_2, when the relative humidity is gradually increased from zero, the metal remains bright. At approximately 50% relative humidity, which is considered the primary critical humidity, there is a marked increase in the weight increment followed at a little higher humidity by the appearance of rust. At approximately 80% relative humidity, which is known as the secondary critical humidity, there is still more pronounced increase in the rate of attack and the specimen becomes rapidly covered with rust. The primary critical humidity marks the requisite relationship between water vapor, O_2 and SO_2 for rusting to commence. The secondary critical humidity depends only on the properties of the initially formed rust and is probably associated with its gel structure and is independent of the presence of SO_2. The influence of suspended solid particles depended on whether they were (1) intrinsically active, as $(NH_4)_2SO_4$; (2) neutral, capable of adsorbing active gases as charcoal; (3) neutral, with negligible capacity for adsorption, as silica. CO_2 had a marked repressive effect on the corrosion of iron under all conditions investigated. 30 references. PRK (13)

Tantalum as a Constructional Material. *Chemical Trade Journal & Chemical Engineer*, Vol. 98, Mar. 6, 1936, page 190. Ta offers excellent resistance to acid corrosion particularly when subjected to combined action of acid and air. It has given good service in direct-fired stills, when proper precautions are observed; storage tanks; and acid vaporizer pipes in chlorination and sulphonation of oils. In fabrication, Ta sheet is similar to Ni. MS (13)

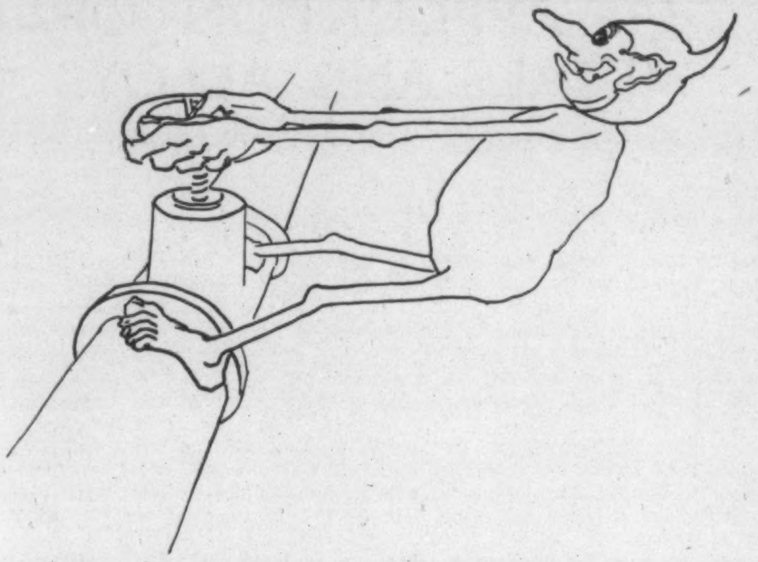
The Influence of Light on Electrode Potential and Corrosion Phenomena of Certain Non-ferrous Metals. C. O. Bannister & R. Rigby. *Journal Institute of Metals*, Vol. 58, Feb. 1936, pages 91-108 (Advance Copy No. 726). Previous work on the influence of light on the corrosion of ferrous and non-ferrous metals is reviewed. A simple apparatus is described for the examination of effects of light on Zn, Pb and other metals under corroding conditions in conjunction with a continuous record of changes of e.m.f. made by a thread recorder. The influence of light was considerable in the case of Pb and Zn, but only in the presence of O, the aerated and illuminated electrode becoming more markedly cathodic. A more elaborate apparatus is then described by which perfect control of O supply is obtained. A very marked response to illumination was found in the case of Zn and Al in the presence of O. The maximum effect was obtained with light in the violet and near ultraviolet region. It is suggested that the mechanism of the phenomenon is the catalysis of the formation of the protective oxide films. 28 references. JLG (13)

The Corrosion Problem in Steel. A. McCance. *Iron & Coal Trades Review*, Vol. 132, Feb. 28, 1936, pages 399-400; Mar. 6, 1936, pages 448-450. The chemical composition of rust has lately been definitely confirmed by the electron-diffraction method to be $FeO(OH)$, regardless of the color of the rust. Heating to 200° C. converts the rust into the magnetic form Fe_2O_3. The various reactions going on in air are described. When immersed in H_2O the rate of rusting is controlled by the amount of O dissolved in the H_2O, and by the rate at which this O can be replenished as it is used up. These conditions are investigated in their dependence on composition of steel and test results shown in curves. The addition of Cu is of benefit in atmospheric corrosion but not in water corrosion. Formation and value of protective films on various steels are discussed, and the inhibiting effect of Na bichromate on corrosion in Na brine shown in a curve. Attention is called to the fact that the number of cases of corrosion in seagoing vessels is on the increase since the war. The explanation given ascribes this increase to secondary causes such as change in practice of shipbuilding but not to any fundamental deterioration in the quality of post-war steel, a view borne out by a statement of the British Admiralty. Ha (13)

The Protection of Water Pipes Against Corrosion. *Engineering*, Vol. 141, Feb. 28, 1936, pages 246-247. From a publication by J. E. Carriere entitled "Het in-en uitwendig Beschermen van Gietijzeren en Stalen Leidingen tegen Corrosie" published by Rijksbureau voor Drinkwatervooziening of The Hague, Holland. LFM (13)

Steel Manufactured in France (Les Aciers de Fabrication Française) *Science et Industrie, Métaux et Machines*, Vol. 19, Dec. 1935, pages 437-441. Present section is devoted to wear resisting steels of the Mn and Cr base type and gives for each type, composition, physical properties, heat treatment and welding, mechanical properties at room and high temperatures, corrosion resistance, machinability, applications. FR (13)

Directions for Corrosion Investigations (Richtlinien für Korrosionsversuche) Report of the Deutscher Normenausschuss. *Zeitschrift für Metallkunde*, Vol. 28, Jan. 1936, pages 19-22. A plan for coordinating and standardizing the investigation of corrosion problems in Germany. FNR (13)



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16 GROUPS OF METALS

CORROSION RESISTANCE OF METALS AND ALLOYS

by Robert J. McKay and Robert Worthington

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The total annual loss from corrosion is tremendous. In one case the wrong use of metal led to the scrapping of several hundred thousands dollars worth of equipment inside a month or two, in another the loss was nearly as great. These losses would have been entirely avoided if one or two perfectly simple facts of corrosion had been understood. Losses on a minor scale, due to lack of understanding, are innumerable.

Corrosion can be made an extremely complicated subject. The authors have not let it become so in this book. They have taken as the basis of discussion the simple facts of what a corrosive will do to metals or how a metal will behave in the face of corrosives. Insofar as possible they have expressed this behavior in quantitative terms. Involved discussion of the theories of corrosion have been avoided, yet enough of this has been included to provide background. The approach is essentially a practical one.

Corrosion knowledge is rapidly increasing. It is believed that the present work of about 500 pages may serve for years to come as a pattern into which each newly discovered fact may be fitted and which thus may provide this fact with its true and useful interpretation.

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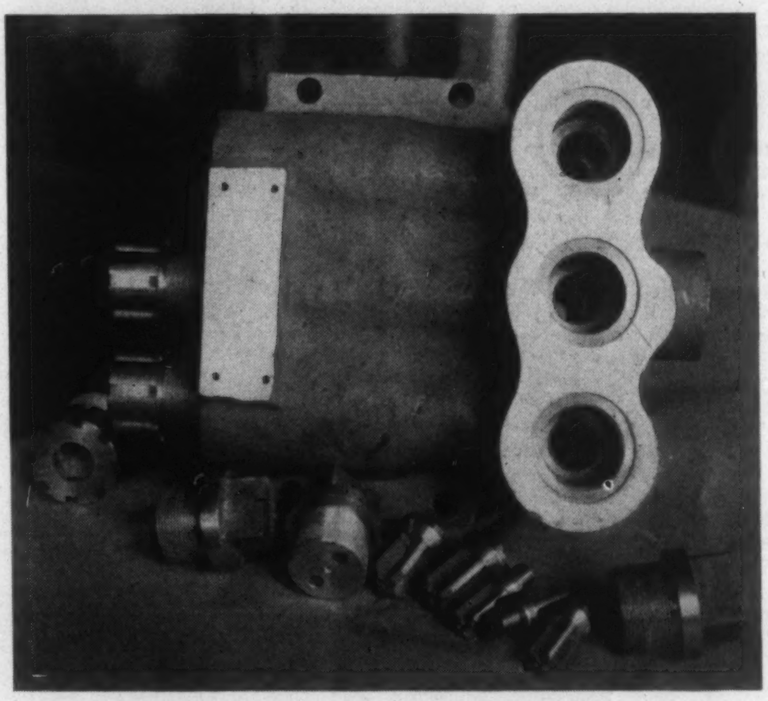

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Some Chemical Aspects of Boiler Plant Maintenance. A. A. Pollitt. *Electrical Review,* Vol. 118, Mar. 27, 1936, page 460. Abstract of paper read before the London Technical Group of the Electrical Power Engineers' Association. Deals, in part, with caustic embrittlement. MS (13)

Wearing Tests with Alloy and Unalloyed Cast Steel (Verschleissversuche mit legiertem und unlegiertem Stahlguss) K. Roesch. *Giesserei,* Vol. 23, Feb. 28, 1936, pages 97-101. 2 methods for testing the wear of cast steels are described, in both the part to be tested is pressed against a surface of 1 cm.^{2} and either moved back and forward or continually over it. Hard Mn cast steel showed rapid increase of wear for very high specific pressure. Hardened steel castings with 400-450 Brinell show a very high wear resistance, e.g. Cr-Ni and Cr-Ni-Mo cast steel. The basis of good wear resistance is pearlite and, to a lesser degree, ferrite. With increasing C content the amount of pearlite increases and therefore also the wear resistance, especially if pearlite is present in coarse laminae; steels with the latter showed 25-30% greater wear resistance than with granular pearlite. A list of publications referring to this subject in the years 1930-35 is added. Ha (13)

Steel Sheets Protected by Sprayed Zinc Coating. W. C. Reid. *Welding Engineer,* Vol. 21, Feb. 1936, page 31. The Zn coating which was destroyed by welding galvanized sheets was replaced by a new sprayed Zn layer which was entirely satisfactory as regards corrosion resistance. Ha (13)

Determination of Oxidation Losses in Rolling-Mill Furnaces (Versuche über den Abbrand in Walzwerksöfen) F. Strähuber. *Stahl und Eisen,* Vol. 55, Nov. 21, 1935, pages 1229-1234. Oxidation losses for various periods of time in different atmospheres are shown in graphs. SE (13)

Investigation of the Question of the Cavitation Erosion of Materials (Versuche zur Frage der Werkstoffanfressung durch Kavitation) H. Schröter. *Zeitschrift für Metallkunde,* Vol. 27, Dec. 1935, pages 287-289. A type of pitting corrosion peculiar to ships' propellers and objects operating under similar conditions has been shown to be due almost wholly to the mechanical errosion caused by the impingement of water moving at high velocities. Glass, bakelite, rubber, Pb, Al, Fe, steel, brass, and bronze were all attacked in the same manner when subjected to the action of a jet of water. It was demonstrated that the resistance of a material to this type of attack is roughly proportional to its hardness. Electrochemical effects appear to play a very minor part, being most noticeable in the case of the polyphase bronzes. The resistance of cast Fe is inferior to that of steel because of the softness of the graphite constituent. FNR (13)

Corrosion Velocity of Duralumin (Zur Korrosionsgeschwindigkeit des Duraluminiums) G. Tammann & W. Boehme. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 226, Dec. 31, 1935, pages 82-86. The effect on velocity of HCl corrosion of Al with Cu in solid solution and precipitated as Al_2Cu was determined. When the Cu is in solid solution, as quenched, the corrosion velocity is a min., heating to 100°, 200°, 300° C. respectively and quenching increases corrosion with 300° C. a max. and higher aging temperatures give decreased corrosion velocity again. WB (13)

Work of French Commission on Corrosion of Metallurgical Products of Interest to Aviation (Recherches relatives aux travaux de la Commission Française de Corrosion des produits métallurgiques intéressant l'aéronautique) R. Legendre Grard & R. Lecoeuvre. *Revue de Métallurgie,* Vol. 33, Mar. 1936, pages 178-188. Summary of the ideas underlying the experimental procedure and its interpretation and presentation as adopted by the Commission. A list of papers published by the workers is given. JDG (13)

Corrosion Problems in the Chemical Industry. James Golder. *Journal West of Scotland Iron & Steel Institute,* Vol. 43, Dec. 1935, pages 43-52. The application of ferrous and non-ferrous metals and of glass lined iron ware for severe corrosion conditions is discussed with numerous examples of both successful and unsuccessful installations. Control of all details and proper understanding of service conditions are essential for satisfactory service. The uses and limitations of various modifications of stainless steel are discussed. These modifications include: 18-8 Cr-Ni, 18-8-1 Cr-Ni-W, 18-8-1-1 Cr-Ni-W-Ti, 18-14-1 Cr-Ni-V, 18-14-2 Cr-Ni-Mo, 18-8-4 Cr-Ni-Mo. FGN (13)

Latex as Economizing and Substitution Material. H. Miedel. *Metalgesellschaft,* No. 11, Feb. 1936, pages 19-24. Besides extensive uses of latex in the textile industry which are described in detail, it is also used to replace in part more expensive materials for protecting metal containers in the chemical and foodstuff industries against chemical influences by spraying a thin layer of latex hard rubber on the metal (especially Fe). The economical advantages, especially from the German point of view in its desire to save expensive imported materials, are discussed at length. Ha (13)

Effect of Composition on the Corrosion Probability of Iron and Steel. R. B. Mears. *Iron & Steel Institute, Carnegie Scholarship Memoirs,* Vol. 24, 1935, pages 69-85. The author shows that scale covered materials give low probability corrosion figures when the scale is coherent and continuous, and comparatively high values when it is loose, scratched, or imperfect. Ferrous and Mn sulphide in aqueous contact with the metal surface increase the probability of corrosion. The presence of hematite or Fe phosphide increases the corrosion probability slightly. Inert substances such as sand, alumina, Fe silicate, magnetite and graphite have no effect. There is a considerable correlation between the corrosion probability value and the amount of S, C, and Mn in the iron. Materials containing high S, C, and Mn give higher average corrosion probability values than those containing low quantities of these elements. Si, P, and C have little effect on the corrosion probability figures. Small quantities of H_2S increase the probability of corrosion of Fe by 0.005 molar $NaHCO_3$ solution, much more than similar amounts of H_2SO_4. CW (13)

The Comparison Between the Effect of Hydrogen-ion Concentration on the Rate of Corrosion of Steel in Pure Oxygen and Air at 25° C. J. M. Bryan. *Transactions Faraday Society,* Vol. 31, Dec. 1935, pages 1714-1718. The main effect of high concentration of O_2 is to mask the effect of pH and to equalize the rate of corrosion in a greater pH range. The evolution of H_2 is inhibited by pure O_2. The acceleration of corrosion in the presence of pure O_2 is entirely due to depolarization. PRK (13)

14. APPLICATION OF METALS AND ALLOYS

Magnesium Alloys in Aeroplanes. E. R. Gadd. *Aircraft Engineering,* Vol. 7, Dec. 1935, pages 299-302. England is now producing Mg from native dolomite ores which are to be found in Derbyshire and other localities. Flux inclusions and 2 forms of porosity are the major difficulties met in casting Mg, flux shows up when part is finish-machined and is shown by local corrosion of the part. Porosity is most serious when present as microscopic type of grain boundary separation. Impregnation is resorted to to make engine component castings pressure tight. Cure for this type of porosity is considered to be in modification of composition. In forging Mg alloys rapid deformation is unsuccessful and greater success is obtained by pressing or extruding. Table of physical and mechanical properties are given for various materials of construction for aircraft for comparison of Mg with Al, etc. Notch tenderness of Mg is greater than Al and tensile test is seriously affected by surface of test specimen. Suggestion made for redesign of casting when Mg is substituted for Al with generous radii and better surface finish. Unless these factors are considered there will be no weight saving over Al. Attempts to use Mg alloy for pistons were unsuccessful due to low thermal conductivity and low strength, 3-5 tons/in.^{2} at 350° C. as compared with 7-9 tons/in.^{2} for Al pistons. Use of Mg alloys in crankcases unsuccessful due to low creep strength at operating temperature. The use of forged Mg alloy, variable pitch propellor is discussed as an important and desirable use of Mg for weight reduction. Other successful applications are for landing wheels, panels, cowlings, oil and fuel tanks, (the latter, however, not in England). Corrosion problems with use of Mg are serious and attempts to prevent corrosion by chromate process and Se deposit, all require after treatment with one or more coats of enamel. As regards galvanic action, the combination of 13% Cr steel-Mg is not nearly as destructive of the Mg as when it is in contact with 18-8. In use of Mg alloy for carburetors as a substitute for Al alloys it is necessary to use 13% Cr steel for bushings instead of the bronzes used with Al. The use of Mg alloys for fuel tanks holding leaded fuel, is reported to be successful on the continent due to suspension of a bag of NaF in the tank to form F salts with moisture in the fuel. The Mg F film formed protects the base against corrosion. WB (14)

Materials of Construction for Chemical Engineering. J. McKillop. *Chemical Trade Journal & Chemical Engineer,* Vol. 96, Apr. 5, 1935, pages 249-250. From paper read before Institution of Chemical Engineers and Manchester Metallurgical Society. Includes consideration of Cr-Ni steels, Fe castings with 6-13% Si, Te-Pb alloys, Al, and Pb-lined and Ni-clad steel. MS (14)

Use of Pure Molybdenum in Electrical Industry (Le Molybdène Pur en Electricité) M. Deribéré. *Science et Industrie, Electricité,* Vol. 19, Dec. 1935, page 553. Pure Mo wire is used for inside contacts and wire and grid supports in lamps and radio tubes, anticathodes for X-ray tubes, electrodes for spark plugs, etc. Mo is also used for heating resistances which can work up to 1500° and even 2000° C. instead of 1000° for Ni-Cr and 1300° for graphite, but Mo resistance must work in H atmosphere. Alloys of Mo such as W-Mo and Ni-Mo have also found applications in the electrical field. FR (14)

14a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Use of Aluminum Foils in the Household (Verwendung von Aluminiumfolien im Haushalt) A. Singer. *Aluminium,* Vol. 18, Jan. 1936, pages 29-30. Bread and meats can be kept fresh by wrapping in Al foil; in baking it prevents the baked dough from sticking to the form. It is used for decorative purposes and is very effective as a scarecrow as the continuously changing reflection of light by the motion of the foil in the wind scares birds away. Al foil is absolutely sterile, germ-free and harmless. Ha (14a)

Copper as a Chemical Plant Material. C. H. S. Tupholme. *Chemical Industries,* Vol. 37, Nov. 1935, page 448. A brief discussion of the corrosion resistant properties of Cu and some of the conditions under which Cu can be used. RAW (14a)

Aluminum for Railway Rolling Stock Construction. A. H. Woollen. *Railway Age,* Vol. 100, Feb. 22, 1936, pages 303-308. A review of the applications of Al alloys to rolling stock. CBJ (14a)

A New Metal Mallet (Ein neuer Metallhammer) K. Wissemann. *Aluminium,* Vol. 17, Dec. 1935, page 644. An alloy of Al-Zn with 7-15% Zn was found to be a very suitable material for a metallic hammer as a substitute for lead hammers as it keeps its shape much longer and is sufficiently deformable not to damage the metal parts on which it is used. Ha (14a)

Requirements of Materials for Weaving Fourdrinier Wires. Hugh E. Brown. *Wire & Wire Products,* Vol. 11, Jan. 1936, pages 15-18, 54. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 422L/1. Ha (14a)

New Use for Tin Compounds. E. W. J. Mardles. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Oct. 12, 1934, page 256. See "The Beneficial Use of Tin Compounds in Lubricants," *Metals & Alloys,* Vol. 5, Dec. 1934, page MA 590. MS (14a)

Application of Welded Aluminum. G. O. Hoglund. *Industry & Welding,* Vol. 8, Jan. 1936, pages 52-56. The characteristics of Al and Al alloys as far as they must be considered in welding are described, welding processes discussed, and typical mechanical properties of wrought Al alloys (16 types) given in a table. Examples of welded structures and apparatus for architectural applications in the transportation field, in brewery and dairy, and in chemical handling equipment are described. Ha (14a)

Aluminum as a German Construction Material (Aluminium ein deutscher Werkstoff für den Apparatebau) H. RÖHRIG. *Chemische Fabrik,* Vol. 8, Dec. 11, 1935, pages 487-489. Commercial Al is now obtainable 99.7% pure. For special purposes a 99.7-99.8% grade is also available. Its cost is higher but its corrosion resistance, especially to HCl is superior. The impurities are mainly Fe and Si. Si is put in solid solution by heating to 400°-500° C. to reduce its harmful effect. Mg is added for resistance to alkalies. Silumin is used for contact with oils and fatty acids. It is important not to damage the oxide coating by scratching or embedding chips of heavy metals, especially Cu. Artificial oxide coatings give better corrosion protection than the natural oxide. The attack of alkali solutions on Al is prevented by adding .5% Na silicate to the alkali which forms a colloidal protective coating. Other colloids can also be used with alkaline sulphides, dyes, alkaline disinfectants and cleaners for milk containers, and alkaline tooth pastes. Colloids are effective in reducing the attack of acids such as HCl on Al, but other inhibitors are used, similar to those used in steel pickling solutions. Al is suitable for chemical equipment because it is easy to form and weld. Autogenous, hammer, arc and resistance welding processes are used. Hammer welding is not suitable if the weld is to be in contact with HCl. CEM (14a)

Traffic Signs of Light Metal (Verkehrschilder aus Leichtmetall) FRITZ RENTEL. *Aluminium,* Vol. 17, Nov. 1935, pages 568-569. Discusses atmospheric corrosion resistance of aluminum. Ha (14a)

Use of the Heat Conductivity of Aluminum for Heating of Floors, System Deriaz (Anwendung der Wärmeleitfähigkeit von Aluminium bei der Fussbodenheizung, System Deriaz) *Aluminium,* Vol. 18, Jan. 1936, pages 19-21. Al heating tubes (radiators) in which hot water or steam circulates were installed in the floor of rooms and proved to be very effective. A more even temperature distribution over section and height of the room was obtained than with the radiators distributed as usual. Ha (14a)

Bell Metal in Bengal. *Aluminium & the Non-Ferrous Review,* Vol. 1, Dec. 1935, page 114. An alloy of 60% Cu, 10% Sn, 30% Zn has been proposed by the Department of Industries, Bengal, India, as a substitute for the traditional alloy of 77% Cu, 23% Sn commonly used for food utensils. JCC (14a)

The Development of the Metal Aeroplane. *Aluminium & the Non-Ferrous Review,* Vol. 1, Dec. 1935, pages 95-96, 98-99. An historical review. JCC (14a)

Fifty Years Development of Important Canning Medium. *Canning Age,* Vol. 17, Feb 1936, pages 69-71. A discussion is given of the advantages and value of Al in the canning industry, both in the form of metal containers and as paint. Non-toxicity, lightness, good heat conductivity, sanitary appearance and resistance to corrosion are outstanding properties. In one investigation it was found that an Al alloy for handling citrus fruit juices was uniformly attacked at a rate of only 0.00017" penetration per year by lemon juice, 0.00020" by orange juice and 0.00024" by grapefruit juice. Al Mason jar tops and even Al cans are now being used. From the successful use of flat Al cans with pressed-on covers for packing tuna—despite the slight premium which the customer had to pay—experiments are now being made to demonstrate the practicability of Al cans for many food products. BWG (14a)

Contemporary Pewter in the Netherlands. *Bulletin No. 3, International Tin Research & Development Council,* Jan. 1936, 62 pages. Price 2s. 6d. post-free, may be obtained free of charge by educational and kindred establishments. Profusely and artistically illustrated. A brief description of the methods of making hand-wrought pewter is included. Of interest to metallurgists as an outlet for metals, and to those of artistic leanings from the beauty of the objects pictured. HWG (14a)

Caustic Soda Evaporation. *Chemical Trade Journal & Chemical Engineer,* Vol. 97, Nov. 8, 1935, page 395. Ni and Monel metal have given excellent service in construction of NaOH evaporators. Where Cu-free product is desired, pure Ni is best. MS (14a)

Chemical Works' Piping Systems. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, July 6, 1934, page 8. Discusses use of Monel metal piping installations in chemical and allied industries. MS (14a)

Castings for Chemical Plant. *Chemical Trade Journal & Chemical Engineer,* Vol. 94, June 29, 1934, page 485. Outlines uses of Ni and Monel metal in chemical equipment where resistance to corrosive media and non-contamination of product handled are required. MS (14a)

Some General Remarks on Copper Compounds (Quelques Généralités sur les Composes du Cuivre) *Cuivre et Laiton,* Vol. 8, Dec. 30, 1935, pages 551-553. The different compounds of Cu which are used in the paint, ceramic, glass, dyeing and other industries are reviewed and their compositions and applications briefly described. Ha (14a)

The Commercial Development of Tungsten. *Engineering,* Vol. 141, Feb. 7, 1936, page 158. Briefly outlines the various uses of W and its compounds and gives some of the recent developments leading to new uses. LFM (14a)

Bronze Bearing Metals. *Mechanical World & Engineering Record,* Vol. 98, Nov. 15, 1935, pages 477-479. A special study of the use of bronze for bearing metals has led to the development of a series of alloys to suit particular circumstances and applications. Some cases are detailed which show the need for matching the bearing alloy to the bearing duty. WH (14a)

Free Cutting Aluminum for Screw Machine Work. *Steel,* Vol. 97, Dec. 23, 1935, pages 27-28. Similar to *Iron Age,* Vol. 136, July 25, 1935, pages 27-29. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 84L/7. MS (14a)

Redesigning to Use Aluminum. GEO. W. DEBELL. *Product Engineering,* Vol. 7, Feb. 1936, pages 42-45. The most important points to be considered when designing with Al or Al alloys to obtain members of equal strength and stiffness as with steel are discussed. The points are exemplified by use of Al in railways. Ha (14a)

Etching Process for Name Plates and Dials. HARRY SHELLY. *Platers' Guide,* Vol. 32, Feb. 1936, pages 12-16. Applications of etching processes are outlined. Difficulties of etching and plating Al are emphasized. WHB (14a)

Using CHACE Thermostatic BIMETAL

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14b. Ferrous

M. GENSAMER, SECTION EDITOR

Weight, Machine Parasite, Cut with Low-Alloy Steels. ALLEN F. CLARK. *Machine Design,* Vol. 7, Dec. 1935, pages 15-18. Discusses Cr-Mn-Si, Mn-Si, Mn-Si-Cr-Cu, Cr-Mo-Cu, Ni, and Mo (low alloy) steels. Physical properties and chemical analyses are listed and applications are pointed out stressing weight saving designs. WH (14b)

Rustless Austenitic Steels in the Dyeing Industry (Los Aceros inoxidables austeniticos en la Industria tintorera) A. BUZZANCA. *Metalurgia y Construccion Mecanica,* Vol. 1, Feb. 1936, pages 4-6. Economies obtained in the use of austenitic Cr-Ni steels for machinery in the textile and dyeing industry because of their resistance to acids and easy handling and assembling by welding are discussed. Ha (14b)

Crates for Bottle Sealed Oil Are Built of Steel Sheets and Flat Wire. *Steel,* Vol. 98, Feb. 10, 1936, pages 45-46. Describes 2 types of crates, parts of which are formed under heavy pressures and assembled by spot welding. They are cleaned, degreased, bonderized, and finished with 1 coat of baked enamel. MS (14b)

Steel Wire Splint Has Advantages. *Steel,* Vol. 98, Feb. 24, 1936, page 61. Describes wire gauze splint, for medical and surgical work, made of standard hardware cloth, reinforced with fine-gage strip steel. Both wire and strip are of Cu-bearing steel. Splint is soft annealed and finished by hot-dip galvanizing. It is easily folded to correct length and molded with fingers to fit injured part. MS (14b)

New Permanent Magnet Can Lift 60 Times Its Weight. *Inco,* Vol. 13, No. 3, 1935-36, pages 10-11. The permanent magnet is made of an Al-Ni-Co alloy (alnico), and owes its excellent magnetic qualities to the fact that it is precipitation-hardening and that its components form carbides in fine distribution. It is non-corrosive, fairly brittle, is used in cast state, and has a sp. gr. of 6.9. Ha (14b)

Alloy Steel Developments. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 49-50. Discusses expanding uses of Cr steels. Tendencies are to use inexpensive mild alloy steels of high tensile strength, such as Cromansil steel, in place of plain C steel; to use more Cr, so that in many cases minimum amount in steel is 11%; and to add Cb to grades other than 18-8 to impart desirable properties. MS (14b)

The Fabrication of Diesel Engine Crankcases. J. THOM. *Welder,* Vol. 8, Dec. 1935, pages 791-792. Electric arc welding in modern locomotive practice is discussed and exemplified by the description of the welded construction of a crankcase for a 1200 h.p. Diesel engine. The case is made up of 267 individual parts. Ha (14b)

The Use of Rock Drills on the Mines. R. S. G. Stokes. *South African Mining & Engineering Journal,* Vol. 46, Part II, Dec. 28, 1935, pages 569, 571-572. From "Recent Developments in Rand Mining Practice," read before Institution of Mining & Metallurgy. Trends in composition of drill steel are discussed. AHE (14b)

Cast Iron for Chemical Plant. J. G. Pearce. *Chemical Trade Journal, & Chemical Engineer,* Vol. 95, Nov. 16, 1934, pages 351-352. See "Modern Cast Irons in Chemical Engineering," *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 378L/8. MS (14b)

Enamelling of Iron. N. H. Oakley-Evans. *Chemical Trade Journal & Chemical Engineer,* Vol. 96, Jan. 4, 1935, pages 7-8. See "Pure Iron for the Enamelling Industry," *Metals & Alloys,* Vol. 6, June 1935, page MA 257L/9. MS (14b)

Cast Ferrous Alloys in the Paper Industry. F. L. LaQue. *Paper Trade Journal,* Vol. 102, Jan. 30, 1936, pages 34-36. A complete flow-sheet for the manufacture of paper by the various processes is given. Table keyed with reference to the flow-sheet gives the materials used in the construction of the various units. CBJ (14b)

Cast Iron in the Chemical Industry (La Fonte dans l'Industrie chimique) A. Guedras. *Revue de Fonderie Moderne,* Vol. 29, Dec. 10, 1935, pages 355-361. Properties which a cast Fe must possess to be a satisfactory material in the chemical industries are discussed. Quite generally the elements used in cast Fe in the order of their importance are, (1) Si, used for handling acidic minerals, (2) Ni, up to high contents; but under alkaline action it should be between 1.5 and 2%, (3) Cr, (4) Mo, which are both added to give a corrosion-resistant material under chemical action, and (5) C, which must always be in the combined state and in case it exists in the graphitic state, must be in extremely fine dispersion as in pearlitic cast Fe. 7 references. Ha (14b)

Staybrite Steel as Applied to the Dyeing Industry. F. Godber. *Journal Dyers & Colourists,* Vol. 52, Feb. 1936, pages 45-48. Staybrite steel contains essentially 18% Cr and 8% Ni. Advantages claimed for its use in the textile industries are: (1) it eliminates damage to fabrics caused by rust and metal staining, (2) it lengthens the life of the plant and reduces the loss of time due to frequent attention, (3) it has alloy steel strength, (4) it is easily cleaned and changes of coloring matter can follow in the same vats in sequence, (5) no boiling out is necessary, (6) a Staybrite steel vat does not absorb dyes, and (7) the resistance offered to the attack of many chemicals does not depend on any surface treatment or superficial plating. WHB (14b)

Simplicity Is Achieved in Steel Garden Chair. *Iron Age,* Vol. 136, Oct. 3, 1935, pages 25. Describes new model steel chair made by L. J. Zerbee & Co., Bellefontaine, O. Instead of having tubular frame between which cross-members are welded or bolted, the entire seat and back is made of a single piece of sheet steel. Strip of automobile spring steel is bent to form the leg and arm. Chairs are made with Cr-plated arms and legs, or in various color combinations in enamel. VSP (14b)

What the S. A. E. Steel Specifications Mean. *Industry & Welding,* Vol. 7, Sept. 1935, pages 53-56. See "New S. A. E. Steel Data Embody Wide Engineering Significance," *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 38L/1. Ha (14b)

Iron Reinforces Concrete Roads. *Foundry,* Vol. 63, Nov. 1935, pages 35, 68. Reviews material taken from "Armature e pavimentagioni metalliche" on cast Fe roads in Italy. Castings are triangular grids placed on road surface and filled with concrete. Discusses shapes other than triangular and also systems used in France and Germany. VSP (14b)

"Isteg" Steel Bars for Concrete Reinforcement. *Engineering,* Vol. 140, Nov. 8, 1935, pages 508-509. The "Isteg" bar consists of 2 strands of ordinary quality mild steel twisted together. The twisting is done cold which results in the material giving a stress-strain diagram without a well-defined yield point so the bars can be stressed well beyond that of a plain bar of the same material. Some tests were carried out on these bars. An "Isteg" rod stressed at 27,000 lb./in.^{2}, consisting of bars each 7/16" in diameter and weighing 1.022 lb./lineal foot is equivalent to a single plain rod stressed at 18,000 lb./in.^{2}, ¾" in diameter and weighing 1.502 lb./ft.^{2} Tests were also made to determine the degree of anchorage of "Isteg" and plain bars in the concrete matrix. The "Isteg" bars were cut off square at the end while the plain bars had the customary hooks. In all tests the "Isteg" bars proved to be superior to the plain bars. LFM (14b)

Standard Specifications for Forge-Welded Steel Pipe. *American Society for Testing Materials,* A. S. T. M. Designation: A136-34; *American Standards Association,* A. S. A. No.: B36.6-1935, 5 pages. AHE (14b)

Standard Specifications for Zinc-coated (Galvanized) Iron or Steel Tie Wires. *American Society for Testing Materials,* A. S. T. M. Designation: A112-33; *American Standards Association,* A. S. A. No.: G8.4-1935, 4 pages AHE (14b)

Standard Specifications for Zinc-coated (Galvanized) Iron or Steel Telephone and Telegraph Line Wire. *American Society for Testing Materials,* A. S. T. M. Designation: A111-33, *American Standards Association,* A. S. A. No.: G8.3-1935, 6 pages. AHE (14b)

Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Wire Strand (Cable). *American Society for Testing Materials,* A. S. T. M. Designation: A122-33; *American Standards Association,* A. S. A. No.: G8.6-1935, 6 pages. AHE (14b)

Standard Specifications for Zinc-Coated Iron or Steel Chain-Link Fence Fabric Galvanized After Weaving. *American Society for Testing Materials,* A. S. T. M. Designation: A117-33; *American Standards Association,* A. S. A. No.: G8.5-1935, 3 pages. AHE (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Alloys and Metals at the Ford River Rouge Plant. *Mill & Factory,* Vol. 18, Jan. 1936, pages 429-455. Forging, casting, heat-treatment, plating, polishing and painting operations are described in considerable detail. Forging developments include simplification of operations, use of automatic feeding, and typing instead of cutting dies. Forging furnaces are largely gas-fired, with duplicate oil fueling available. The manufacture of steel-backed Cu-Pb bearings is characterized by continuous casting of Cu-Pb on both sides of a steel strip, which is in turn formed into a semicircle and machined to bearing size. Complete analysis specifications and Ford standard designations of 53 types of steel used in the car are tabulated. The melting, pouring, etc. of the cast alloy steel piston and the revolutionary cast alloy Fe camshaft and crankshaft are described. Cast Fe cylinder blocks are poured continuously at the rate of 850 tons of metal per 16 hour day. 25 bell-type furnaces, each with a 22,000 lbs. capacity, satisfy the strip steel bright annealing requirements. Metal cleaning is accomplished with either alkaline solutions or organic solvents and with sand, shot and steam jet blasting, and electrolytic cleaning. Non-ferrous metal operations include die-casting of Zn parts with permanent molds and Cu-Ni, brass, Cr, Cd and Zn plating of various parts. "Granodizing," the electrolytic deposition of Zn phosphate with alternating current, is the rust proofing method used for most pieces, although fenders and other very large sections are rust-proofed by conventional methods. 32 heat treating operations are described, with details of temperatures, cool or quench media, hardness and uses of the treated part or tool. The processes of hard Cr and bright Cr plating, rust-proofing, Butler finishing, etc. are minutely detailed, and the salt spray tests and finish-quality specifications are outlined. FPP (15)

New English Steel Works in Corby (Neues englisches Hüttenwerk in Corby) *Stahl und Eisen,* Vol. 55, Nov. 14, 1935, pages 1214-1219. General description of blast furnaces, basic bessemers, and rolling mills. SE (15)

Molybdenum. Its Ores. Its Industry (Le Molybdène. Ses minerais. Son Industry) M. Deribéré. *Science et Industrie, Métaux et Machines,* Vol. 19, Dec. 1935, pages 407-411. Reviews chief forms under which Mo is found in nature. Molybdenite is said to be the most common ore for practical metallurgy. Historical sketch of Mo is given. Physical and chemical properties are discussed. Then general applications are reviewed, i.e.: silico-Mo is of little use. Mo steels with 5-10% Mo are tool steels, steels with 0.5-2% Mo are intended for structural purposes. Mo is commonly used in complex steels such as Si-Mo of the Durichlor type, Cr-Mo, Cr-Al-Mo, Cr-Mn-Mo, Ni-Mo, Ni-Cr-Mo steels, the latter for case hardening purposes, Ni-Cr-Mo steel, special attention being given to the latter type of steel which has many applications, particularly as castings, which have as high a wear resistance as high Mn steel castings and have a better weldability. Ni-Cr-Al-Mo steel for case hardened parts having a thick hardened depth by quenching, Mn-Mo, Co-Mo steels, the latter being a new development in the permanent magnet field. Last section of the article deals with Mo cast Fe. FR (15)

Investigation of Alloys Prepared by Ceramic Methods. N. Zarubin & M. Suitin. *Redkie Metallui,* Vol. 4, July-Aug. 1935, pages 21-25. In Russian. Alloys of WC and Fe containing 5-90% WC and of Mo_2C and Fe containing 2 to 90% Mo_2C were prepared by sintering at 1450° C. for 1.5 hours. The solubility of WC in Fe was found to be about 5% and of Mo_2C about 2%. In both systems eutectics containing about 30% carbide are formed. HWR (15)

Production of High Quality Hard Alloys. N. M. Zarubin. *Redkie Metallui,* Vol. 4, Nov.-Dec. 1935, pages 18-23. In Russian. The presence of free C in the WC-Co mixture causes a porous microstructure. The presence of free W or of Co oxide causes segregation in the sintered alloy. HWR (15)

Some Aspects of the Selection of Engineering Materials. L. B. Hunt. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 479-500. See *Metals & Alloys,* Vol. 4, Dec. 1933, page 377. CEJ (15)

Metallurgical Processes in Iron and Steel. Stanley R. Keith. *Iron Age,* Vol. 137, Jan. 2, 1936, opposite page 120. A chart claimed to be the most comprehensive, traces in detail the wide-spread branches of iron and steel manufacture. Of reference value to consumers as well as producers. VSP (15)

The Steel Works of the South African Iron and Steel Industrial Corporation in Pretoria (Das Hüttenwerk der South African Iron and Steel Industrial Corporation in Pretoria) W. Krebs. *Stahl und Eisen,* Vol. 55, Oct. 3, 1935, pages 1057-1065. Layout and practice are described. SE (15)

Modernization Miracles. *Mill & Factory,* Vol. 18, Jan. 1936, pages 89-108, 585. Detailed description is given of the general expansion and modernization program of the Ford Motor Co.'s River Rouge plant. Blast furnace "B" was enlarged and rebuilt, increasing its capacity 60%. New hot strip and cold finishing rolling mills, capable of rolling a 10 ton ingot to .065" sheet in 12 minutes with a single reheat were provided at a cost of 10 million dollars. Complete description of capacity and equipment of new mills, auxiliary heating equipment, conveyors, etc., and a process flow chart of the entire steel plant, with roll pass details, are included. FPP (15)

Screwing Light Metal Screws into Wood (Ueber das Endrehen von Leichtmetallschrauben in Holz) Nicolini. *Aluminium,* Vol. 3, Feb. 1936, pages 60-62. In order to make light metal screws turn easily into hard wood it is recommended to dip them in molten wool fat. The effect can still be enhanced by reinforcing previously the natural oxide film by the eloxal process. Ha (15)

15a. Economic

Future Development of German Iron Foundries (Die zukünftige Entwicklung der deutschen Eisengiessereien) TH. GEILENKIRCHEN. *Giesserei,* Vol. 23, Jan. 17, 1936, pages 25-27. Formation of a cartel among the iron foundries to promote unification of production and products, improvement of qualities and general economical conditions are discussed. The future trend will be to use a high-grade cast Fe which approaches forged and cast steel; castings of much thinner walls will be used in machine tools and machinery in general to compete with light metal constructions. A still more pronounced utilization of scientific results in practice is to be expected. Ha (15a)

Economic Conditions in South Africa. A. W. H. HALL. *Iron & Coal Trades Review,* Vol. 132, Feb. 28, 1936, page 405. Report of the Overseas Trade Department on Fe ore resources and imports of Fe and steel. Ha (15a)

Iron and Steel Imports into Finland. KEITH JOPSON. *Iron & Coal Trades Review,* Vol. 132, Mar. 27, 1936, page 591. Statistics on the economical conditions and the various Fe products figuring in the trade with Great Britain. Ha (15a)

The World Iron and Steel Industry. WM. J. LARKE. *Iron & Coal Trades Review,* Vol. 132, Jan. 17, 1936, pages 120-121. Review, statistical charts and outlook on potential world consumption. Ha (15a)

Consumer Requirements Now Dictate Mill Equipment. T. W. LIPPERT. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 430-431, 434, 436, 438, 440, 442, 444-445. Reviews some of the more important developments in steel mill practice, such as continuous and strip mills, cold rolling practice, use of antifriction bearings, strip making by slitting continuous sheets, cold forming of shape, and advancements in annealing and sorting sheets, and new ingot heating furnace. VSP (15a)

Consumption of Non-Ferrous Metals Increased in 1935. NEIL E. MACMILLAN. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 130-133. Marketing of non-ferrous metals, though faced with conflicts and uncertainties, improved. Consumption of Cu, Pb, Sn and Zn during 1935 was in each case greater than in 1934. Includes table and graph showing production and price of non-ferrous metals for a number of years. VSP (15a)

Presidential Address. W. R. BARCLAY. *Journal Institute of Metals,* Vol. 58, Mar. 1936, pages 131-152 (Advance Copy No. 729). **The Non-Ferrous Metallurgical Industry.** *Engineer,* Vol. 161, Mar. 13, 1936, pages 282-284. Describes development organizations of the Ni, Al, Cu and Sn producers. Work of each of these organizations is described, and the fields that should be covered by such groups are discussed. JLG + VSP (15a)

Light Materials Gain Favor Among the Railroads. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 56-57. Railroad buying declined in the first 11 months of 1935. Despite this decrease, the outlook at the end of the year was regarded as auspicious. For the new streamlined trains stainless steel and Al alloys were in demand. In freight equipment field, low-alloy high-tensile steels were used. Bringing out of light high-tensile materials caused new developments in rolling mill practice. VSP (15a)

Scrap Exports Gain in 1935. *Iron Age,* Vol. 137, Jan. 2, 1936, page 90. Export of scrap Fe and steel is estimated at 2,140,000 tons, as against 1,835,554 tons in 1934. The exports to each country were:

Japan	991,828	tons
Italy	322,541	”
United Kingdom	219,512	”
Poland and Danzig	36,040	”

Gives a chart showing Fe and steel scrap exports by months in relation to weekly steel ingot rate, and composite price for heavy-melting steel. VSP (15a)

Steel Housing Progress in 1935. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 140-142. Lists the various concerns building steel houses, the number of houses built by each, kind of steel used and average number of tons of steel used for each house. VSP (15a)

Steel Industry Undertook Many Improvements in Plant Facilities During 1935. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 124-125, 128-129. Lists the major improvements completed during 1935 or under way at the end of the year. VSP (15a)

A Symposium on Progress. *Iron Age,* Vol. 137, Jan. 16, 1936, pages 14-23. Gives the opinion of a number of American and foreign metallurgists, and industrialists on the most conspicuous improvements in manufacturing procedure or outstanding contributions to metallurgy during the past year. VSP (15a)

Iron and Steel Trade with Lithuania. *Iron & Coal Trades Review,* Vol. 132, Feb. 21, 1936, page 348. Report of the Overseas Trade Department (Great Britain) on economic conditions in Lithuania, in particular on the industries which at present employ only 20,000 workers. Conditions in Fe consumption and manufactured goods are described. Ha (15a)

The German Economical Aluminum Situation in 1935 (Die deutsche Aluminiumwirtschaft im Jahr 1935) A. DEDERER. *Aluminium,* Vol. 18, Feb. 1936, pages 66-69. The development of the German Al industry in 1935, production, consumption, import and export and the role which Al plays in German international trade relations are discussed. Ha (15a)

International Annual of Minerals and Metals (Annuaire International des Minerais et Métaux). Société des Publications Minères et Métallurgiques, Paris, 1935. Fabrikoid, 6½ x 10 inches, 395 pages. Price 55 Fr. Directory of producers in France, French colonies, Luxemburg, Belgium and Belgium Congo. (15a)-B-

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15b. Historical

Inspection of Cast Iron Pipe in the Late Nineties. R. A. BULL. *Metals & Alloys,* Vol. 6, Nov. 1935, page 332. Descriptive. WLC (15b)

Nickel and Cobalt Refining. *Chemical Trade Journal & Chemical Engineer,* Vol. 96, May 10, 1935, pages 355-356. History of Henry Wiggin and Co., Ltd., which has been in business 100 years. MS (15b)

Metallurgy of Gold and Platinum Among the Pre-Columbian Indians. PAUL BERGSOE. *Nature,* Vol. 137, Jan. 4, 1936, page 29. Discusses new finds of half-finished objects of Au, Pt and Au-Pt alloys from Ecuador. The objects are never cast, but are wrought or made from plate or wire and throw light on the metallurgical processes of the South American Indians before the time of Columbus. Au was melted on wood charcoal with the aid of a blowpipe; wires were drawn from 2 mm. to 0.1 mm. diameter. Pt cannot be melted by primitive means. Pt grains were apparently mixed with Au and joined by melting the Au, which diffused into the Pt; alternate heating and hammering eventually produced a homogeneous Pt-Au alloy (about 30% Au). CSB (15b)

History of Tin Plating. A. EYSPAMER. *Monthly Review American Electroplaters' Society,* Vol. 23, Jan. 1936, pages 25-37. Electroplating of Sn had not been applied extensively until the recent application on coils and other parts of domestic refrigerators. Plating Sn by immersion, on the other hand, has been done on large quantities of pins, thimbles, buttons, etc., made of brass. A common solution for immersion tinning is a saturated solution of cream of tartar plus 15-30 g./l. of Sn chloride. Articles are placed in the boiling solution and kept in contact with metallic Sn. Other formulas are given with references. Many additional references are given, with brief notes and formulas, on the electrodeposition of Sn using external current. GBH (15b)

Alloy Steels—A Historical Review. FREDERICK B. HUFNAGEL. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 81, 84. Address before American Institute Metal Products Exhibit. Egyptians and American Indians used meteoric Fe. Swords of Middle Ages contained alloying elements. First scientific study of Fe and steel alloys was made by Faraday in 1820. Commercial alloying was introduced by Mushet shortly after 1850 and was confined to tool-steels until 1890, when Ni steel was used for armor-plate. Greatest progress has been made in this century. MS (15b)

History of Hammer and Wire Mills in Ferlach and Waidisch (Zur Geschichte der Hammer- und Drahtwerke in Ferlach und Waidisch) LUDWIG JAHNE. *Montanistische Rundschau,* Vol. 28, Feb. 16, 1936, pages 1-4. A historic review of 2 Austrian metallurgical plants which date back to about 1650. While the Waidisch plant was closed down permanently about 40 years ago, the Ferlach mill has been modernized and is still in operation. The entire mill is now electrified. BHS (15b)

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History of Iron (Eisen in geschichtlicher Darstellung) MAX PASCHKE. *Giesserei*, Vol. 22, Nov. 8, 1935, pages 553-561. Development of production of Fe in general and in Germany in particular is given. 25 references. Ha (15b)

On the Structure of Armor, Ancient and Modern. WILLIAM CAMPBELL. *Metals & Alloys*, Vol. 6, Oct. 1935, pages 267-272. Shows 19 micrographs of armor steel dating back to 1460. WLC (15b)

Cast Iron—It Dates Back to 300 B.C. RALPH M. SHAW. *Iron Age*, Vol. 137, Jan. 30, 1936, pages 24-27. Recent findings show that the metallurgy of Fe and steel had its real beginnings in ancient China and not in Europe. According to writings of H. T. Chang the age of cast Fe originated between 300 B. C. and 100 A. D. Dawn of the age of Fe may be assigned to centuries preceding the period of Ch'un-Chiu, about 722 to 481 B. C. Other data show that Meng Tzu, 372 to 289 B. C. used an Fe plow. Anthracite coal as fuel was used about 1100 A. D. Original Chinese method of Fe manufacture is described in an ancient technical book, "Meng Hsi Pi Tan." It corresponds to modern practice. A notable application of cast Fe for roofing is found in Tai Shan temple, built about 500 years ago and still in service. VSP (15b)

The Dillingen Works (L'Usine de Dilling) H. VAN HAM. *Revue Technique Luxembourgeoise*, Vol. 28, Jan.-Feb. 1936, pages 14-20. The history of this Works on the occasion of its 250th anniversary and its pioneering work in the field of metallurgy, especially non-ferrous metallurgy, is narrated. Ha (15b)

From the History of Aluminum. 2. Manufacturing Methods for Aluminum and Aluminum Bronze (Aus der Geschichte des Aluminiums. 2. Herstellungsverfahren für Aluminium und Aluminiumbronze) W. KIRCHNER. *Aluminium*, Vol. 18, Jan. 1936, pages 33-36. The history of the first Al plant in Germany, Hemelingen, since 1887, the electrochemical processes developed for the production of Al and Mg, production statistics and equipment are described. Ha (15b)

Barbed Wire. C. M. VANDEBURG. *Wire & Wire Products*, Vol. 11, Feb. 1936, pages 78-79. History and development of barbed wire, and its applications are described. Ha (15b)

Oxyacetylene Process Cuts Cost of Making Steel. W. D. WILKINSON. *Steel*, Vol. 97, Nov. 4, 1935, pages 92, 94, 96. Condensed from article in *Oxy-Acetylene Tips*, Nov. 1935. See *Metals & Alloys*, Vol. 7, Feb. 1936, page MA 90R/6. MS (15b)

A Note on Some Ancient Copper-coated Silver Coins of Cyprus. STANLEY G. WILLIMOTT. *Journal Institute of Metals*, Vol. 55, No. 2, 1934, pages 291-294. See *Metals & Alloys*, Vol. 6, Mar. 1935, page MA 130R/6. (15b)

The Work of Walter Rosenhain. J. L. HAUGHTON. *Journal Institute of Metals*, Vol. 55, No. 2, 1934, pages 17-32. 13th Autumn Lecture, Sept. 1934. See *Metals & Alloys*, Vol. 6, Feb. 1935, page MA 82R/8. (15b)

MANUFACTURERS' LITERATURE

Heat Exchanger

Bulletin No. 173 describes the Duriron heat exchanger which is available in the company's corrosion-resisting alloys—Duriron, Durichlor, Durimet, Durco Alloy Steel and Alcumite. Illustrated. Duriron Co., Dayton, O. (567)

Salt Bath Furnace

Although the advantages of molten salt baths have been recognized, they have not attained widespread use because of the shortcomings of furnace designs. The Ajax-Hultgren electrically heated salt bath was designed to meet the metallurgical requirements of liquid heat treating operations. Bulletin 103 lists some of the advantages of the furnace. Illustrated. Ajax Electric Co., Inc., Philadelphia, Pa. (568)

Kramer Alloy News

This publication is of interest to users of non-ferrous ingot metals. The importance of research is stressed in this special Foundrymen's convention number. H. Kramer & Co., Chicago, Ill. (569)

How to Bronze-Weld

This booklet contains a practical presentation of the fundamental theory and technique of bronze-welding and bronze-surfacing. The advantages of speed and economy are discussed, as well as the ability of bronze-welding to accomplish jobs which, according to the manufacturer, might otherwise be difficult or impossible, such as the joining of dissimilar metals. Linde Air Products Co., New York, N. Y. (570)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections Available Forms and Shop Practice, has been published by The Dow Chemical Co., Midland, Mich. (571)

Aerocase

Booklet on this subject. Illustrations, curve charts, tables. American Cyanamid and Chemical Corp., New York, N. Y. (572)

Dolomite Refractories

This interesting pamphlet presents the case of Clinkered vs. Calcined Dolomite in the basic open-hearth steel furnace. Basic-Dolomite, Inc., Cleveland, O. (573)

Sixteen Sins of the Cleaning Room

Are listed in a circular for convenience in checking on cleaning rooms. Great Lakes Foundry Sand Co., Detroit, Mich. (574)

Metallurgy of Wire Manufacture

This paper contains valuable and interesting data and was presented by H. W. Graham, general metallurgist of Jones & Laughlin Steel Corp., Pittsburgh, Pa. (575)

Refractory Cement

Bulletin No. 317, describes Q-Chrome neutral-base refractory cement which was designed for severe-service duty. Quigley Company, Inc., New York, N. Y. (576)

Value of Draft Control

Bulletin No. L-125 is devoted to the above subject and points out the proper value of the furnace draft and this company's control which consists of a draft switch, a damper motor and a manual station. Illustrated. Shallcross Controls, Inc., Milwaukee, Wis. (577)

Lectrodryer

Bulletin DP discusses the Lectrodryer which was designed specifically for the drying of air, gases and certain vapors and liquids, using activated Alumina, a solid adsorbent. Illustrated. Pittsburgh Lectrodryer Corp., Pittsburgh, Pa. (578)

Industrial Furnaces

This catalog describes, illustrates and gives specifications for furnaces suitable for various applications. Mahr Manufacturing Co., Minneapolis, Minn. (579)

Special Atmospheres in the Heat Treatment and Razing of Metals

A reprint of the above article by C. L. West, Research Engineer, is offered by The Electric Furnace Co., Salem, O. (580)

Free-Cutting Phosphor Bronze—Nickel Silver

Information on outstanding characteristics and diversity of applications of these metals is contained in an illustrated leaflet. Other products of the company are also listed. The Riverside Metal Company, Riverside, N. J. (581)

Seamless Flexible Tubing

Bulletin 1936-1 contains the statement that American tubing is the most reliable type of flexible metal conveyor obtainable for services where absolute, 100 per cent tightness is essential. American Brass Company, Waterbury, Conn. (582)

Sicromo Steel

High temperature data sheets containing full information on this steel have been issued by The Timken Steel & Tube Co., Canton, O. (583)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (584)

Research Puts the Diatom to Work

This booklet discusses the history of the diatom from which Celite is made. The four main industrial services of Celite: high temperature insulation, a filter aid, mineral filler and workability agent in concrete are described. Illustrated. Johns-Manville, New York, N. Y. (585)

Granite City HS Grades 1 and 2

Information concerning the Granite City manganese high tensile steels can be obtained from the Granite City Steel Co., Granite City, Ill. (586)

MoTung High Speed Steel

An illustrated booklet devoted to the above, contains information under these divisions: working and treatment, surface protection, high heat temperatures, drawing temperatures, effect of treatment, etc. An index is included. Universal Steel Co., Bridgeville, Pa., and Cyclops Steel Co., Titusville, Pa. (587)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (588)

Electric Welding Products

Catalog No. 101 contains information on welding rods (recommended uses for the different types, physical properties, welding procedure, etc.); miscellaneous apparatus, and Wilson arc welding machines. Air Reduction Sales Co., New York, N. Y. (589)

Arc Welding

A book "Automatic Arc Welding by the Electronic Tornado" gives a full explanation of this system of automatic carbon arc welding. Lincoln Electric Co., Cleveland, O. (590)

Sonittep Products

This booklet discusses heat loss and its control. The advantage of Sonittep insulating cement and its uses are listed. Instructions for its application are included. Graphs. George F. Pettinos, Inc., Philadelphia, Pa. (591)

Sintered Carbides

This new booklet contains quite complete information on Firthite cutting tools which, the manufacturer claims, increase and better production and reduce tool cost. Firth-Sterling Steel Company, McKeesport, Pa. (592)

Centrifugal Castings

Bulletin C-2 is devoted to these castings which are available in the same analyses as the stationary-cast range of heat and corrosion resistant alloys which they supplement. Michigan Steel Casting Co., Detroit, Mich. (593)

Flex-Arc Rays

Data bulletins containing information on arc welding are published by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. (594)

Refractories and Crucibles

An attractive book gives an abundance of information on super-refractories, high temperature cements, Tercod crucibles and Electroloys. Electro Refractories & Alloys Corp., Buffalo, N. Y. (595)

Atmospheric Burners

Bulletin 133-3 is concerned with the Sincro Venturi Atmospheric Burners and Immersion Burners. Illustrated. Philadelphia Drying Machinery Co., Philadelphia, Pa. (596)

Modern Metal Treatment

A colorful pamphlet lists the R & H chemicals available for heat-treating, electroplating and for cleaning metals. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (597)

Wheelabrator Tum-Blast Cleaner

This cleaner, which it is claimed sets the highest standard of efficiency ever attained in an abrasive cleaning machine is a combination of the Tum-Blast Cleaner and the Wheelabrator. Book 111 is devoted to it. American Foundry Equipment Co., Mishawaka, Ind. (598)

Application of Heat to Core baking

A profusely illustrated booklet containing information resulting from research on the subject has been published by the American Gas Association, New York, N. Y. (599)

Aluminum Flux

A pamphlet entitled "Look into the Ladle" describes how this flux supplies the chemical and metallurgical needs in the melting of aluminum. The Maluminum Co., Indianapolis, Ind. (600)

MANUFACTURERS' LITERATURE

Micromax Electric Control

A complete control system for regulating input in proportion to demand is the subject of Catalog N-OOA. It is based on a simple potentiometer balance and consists of three parts, Micromax control instrument, relay detector and valve mechanism. Illustrated. Leeds & Northrup Co., Philadelphia, Pa. (601)

Cupola Blowing

Motorblowers avoid the loss of air and coke by accurately controlling the weight of air supplied to the cupola. The principles of operation of this automatic air-weight control are described and illustrated in a bulletin issued by Ingersoll-Rand, New York, N. Y. (602)

Indicating and Recording for Rolling Mills

United Pressuremeter indicates rolling pressures at as many points as is advantageous and records at still another location. The manufacturer claims that it is rugged, sensitive and easily adjustable. Illustrated booklet. United Engineering and Foundry Co., Pittsburgh, Pa. (603)

Convected Air Tempering Furnaces Heated by Gas

Bulletin No. 40 concerns these furnaces which use the principle of mechanical convection to the maximum by incorporating in the design a patented rotary fan to drive the heated air downward with pressure and great velocity, in and around through the parts to be processed. Despatch Oven Company, Minneapolis, Minn. (604)

Pyrometers

Alnor pyrometers for molten nonferrous metal service are described in Bulletin No. 1724. Suggested applications for the different types are included. Illustrated. Illinois Testing Laboratories, Inc., Chicago, Ill. (605)

Silica Firestone

Buckeye silica firestone linings are natural products. A selected Split Rock is used in its manufacture which, because of a combination of its peculiar granular structure and chemical analysis, coupled with the colloidal silica bond, has an extraordinary resistance to combined fire and abrasion, according to this company. Well illustrated bulletin, No. 15A, featuring history, technology, splitting and working the stone and refractory uses. Cleveland Quarries Co., Cleveland, O. (606)

Spencer Turbo-Compressors

This bulletin which has illustrations of the complete range of sizes of this equipment also contains: "Midget" Turbo for individual mounting, a single-stage line which effects new economies and Gas-Tight Turbos for acid and explosive gases. Spencer-Turbine Company, Hartford, Conn. (607)

Armco H.T.-50

An illustrated folder devoted to the above alloy steel contains data on the average physical properties, corrosion resistance and forming and welding qualities. American Rolling Mill Co., Middletown, O. (608)

Radium for Industrial Radiography

This article written by R. A. Gezelius and C. W. Briggs, containing interesting and important information on the subject, is published in handy booklet form. Radon Company, Inc., New York, N. Y. (609)

What Scientists Say of Leitz Ultropak

Bulletin No. 17 describes the personal experiences and applications to which Ultropak has been placed by scientific workers in various fields. Profusely illustrated. E. Leitz, Inc., New York, N. Y. (610)

Polishing Machines

A portable model and a floor model of these new metallographic machines are described and illustrated in a pamphlet from Eberbach & Son, Co., Inc., Ann Arbor, Mich. (611)

Cor-Ten and Man-Ten

Pamphlet describing high-tensile steels developed to meet the need of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (612)

Rolled Manganese Products

The Rol-Man products have a chemical analysis which precisely follows the original Hadfield formula which assures toughness, strength and wear resistance in manganese steel. According to this manufacturer, their process of hot rolling and discarding of ends produces a steel with purity, strength, tough hardness, ductility and wear resisting qualities double those of cast manganese steel. An alphabetical index of various products which they have made or can produce in forged, stamped or rolled manganese steel is included. Manganese Steel Forge Co., Philadelphia, Pa. (613)

New Light Hoist

Bulletin H-1 describes the Zip Lift line of hoists which are designed for use where loads must be moved fast and at low cost. Complicated wiring has been eliminated so that for hook, trolley or jib crane service the hoist needs only to be hooked up and plugged in. Harnischfeger Corp., Milwaukee, Wis. (614)

Thermalloy Castings

Bulletin 101 contains information on Ni-Cr castings for heat and corrosion resistance which are X-ray inspected. Electro Alloys Co., Elyria, Ohio. (615)

Liquitol

Bulletin A1-16-A deals with the use of Liquitol for iron and steel castings and ingots. Alpha-Lux Co., Inc., New York, N. Y. (616)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (617)

High Temperature Resistance Alloys

Kanthal alloys, made of chromium, aluminum, cobalt and iron, in three grades for different temperatures, are discussed in a leaflet offered by The C. O. Jelliff Mfg. Corp., Southport, Conn. (618)

A. W. 70-90

This bulletin describes the new high-strength "70-90" steel in sheets and plates. An article on the engineering aspect of high-strength sheet steels is included. Alan Wood Steel Co., Conshohocken, Pa. (619)

Bearing Security

This leaflet lists the four essentials of a bearing metal and claims that Ajax Bull Bearing alloy embodies them. Ajax Metal Co., Philadelphia, Pa. (620)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (621)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (622)

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (623)

Welding Rods

Hard-facing welding rods Nos. 459 and 217 are the subjects of an illustrated brochure. Hard surfacing can be done with these rods, either electrically or by the oxy-acetylene process to the great majority of ferrous welding parts. American Manganese Steel Co., Chicago Heights, Ill. (624)

Bronze Bearing Service

A bearing counselor service has been established by this company, whereby engineers and metallurgists study the customer's application and offer advice as to what type of bearing will be most satisfactory. This leaflet contains information regarding the service. Johnson Bronze Co., New Castle, Pa. (625)

Alloy Steels

A colorful folder devoted to these steels lists some of the advantages to be obtained by their use. A list of the more commonly used grades that are in constant demand is included. Bliss & Laughlin, Inc., Harvey, Ill. (626)

Hardness Tester

Catalog No. 10 is devoted to the "Rockwell" hardness tester which was designed for use on all metals in the laboratory or the shop. The principles of the tester, which is a combined press, weighing machine and micrometer, are described and illustrated. Wilson Mechanical Instrument Co., New York, N. Y. (627)

Gas Fired Furnace

The manufacturer of the gas fired Lindberg Cyclone furnace for heating at temperatures from 250 deg F. to 1400 deg. F. claims that the heating rate is remarkably fast, and either open or extremely dense charges are handled with equal facility. The principle of the furnace is described in Bulletin 51. Illustrations. Lindberg Engineering Co., Chicago, Ill. (628)

Inhibitor

Grasselli 3 inhibitor for efficient, economical pickling is the subject of a booklet of The Grasselli Chemical Co., Inc., Cleveland, O. (629)

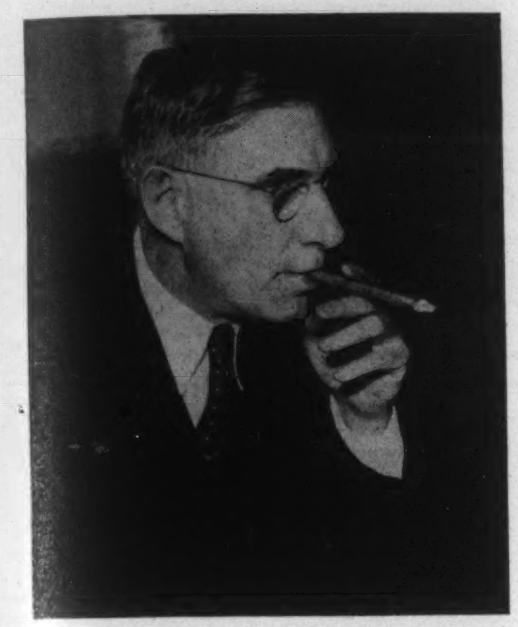
Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (630)

CURRENT NEWS ITEMS

Wetherill Medal to A. L. Marsh

Several honors were bestowed by the Franklin Institute of Philadelphia at special exercises on May 20 in the award of medals.



A. L. Marsh

Prominent among these was the bestowal of the John Price Wetherill Medal on Albert L. Marsh, president of the Hoskins Mfg. Co., Detroit, makers of electric furnaces, pyrometers and resistance wire. Mr. Marsh received this distinguished award "in consideration of the contribution of a material which has proved of extreme importance to the electrical industries." This material is "Chromel," developed and perfected by Mr. Marsh after years of intensive experimentation and research. The medal was founded in 1925 by the family of Mr. Wetherill and awarded for "discovery or invention in physical sciences or for new and important combinations of principles or methods already known."

Other Awards

The Edward Longstreth Medal, founded in 1890 by the late Edward Longstreth of Philadelphia, retired member of the Baldwin Locomotive Works, for the encouragement of invention, was awarded to Dr. Alfred V. de Forest, president of the Magnaflux Corp., New York, and associate professor in the Massachusetts Institute of Technology. It was also awarded to Elmer A. Sperry, Jr., vice president, Sperry Products, Inc., Brooklyn.

The Franklin Medal, founded in 1914 by Samuel Insull of Chicago, a long-time member and friend of the Institute, was bestowed on Dr. Frank B. Jewett, vice president of the American Telephone and Telegraph Co., and president of the Bell Telephone Laboratories. This medal was also awarded to Dr. Charles F. Kettering, vice president and director of General Motors Corp., "in recognition of his significant and timely contributions to the science of automotive engineering."

New Officers of the Foundrymen

James L. Wick, Jr., president and general manager, Falcon Bronze Co., Youngstown, O., was elected president of the American Foundrymen's Association at the annual business meeting of that organization held during the convention last month in Detroit. This honor comes to Mr. Wick after a long career of distinguished service to the foundry industry and in the affairs of the A.F.A. For many years, he has been active in the cost work of the association and has taken an active part in the affairs of the nonferrous division. Prior to his election to the presidency, he was vice president and chairman of the divisional activities correlation committee.

Hyman Bornstein, director, testing and research laboratories, Deere & Co., Moline, Ill., was elected vice president of the American Foundrymen's Association at the same meeting. Mr. Bornstein well merits this recognition for he has been one of the most active members of A.F.A. for many years. He has been active in committee work, serving at various times as chairman of the committee on gray iron castings, member of the committee on specifications for malleable castings, member of the committee advisory to liquid shrinkage investigation of metals advisory to the Bureau of Standards, member ferrous metals advisory committee to the Bureau of Standards, member of committee on metallography and many others. At present, he is general chairman, Gray Iron Division of A.F.A., and chairman, Alloy Cast Iron Committee. He also served as a director of A.F.A. from 1932 to 1935. Mr. Bornstein has had a distinguished career in the metallurgical field and is recognized both nationally and internationally as a leading authority on cast iron.

For directors the following were selected:

Dan M. Avey, editor of "The Foundry," who has just completed two successful terms as president. This is his second term as a director, his first term being 1931 until his election to the vice presidency in 1933; Carl C. Gibbs, president, National Malleable & Steel Castings Co., Cleveland; Marshall Post, vice president, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; James R. Allan, for 25 years connected in various capacities with the International Harvester Co., Chicago, and Lester N. Shannon, vice president, Stockham Pipe Fittings Co., Birmingham, Ala.

Testing Society's Annual Meeting

According to announcements of the secretary of the American Society for Testing Materials, a large number of technical papers and reports are scheduled for presentation during the 1936 annual meeting at Chalfonte-Haddon Hall, Atlantic City, June 29 to July 3. Some 20 sessions have been scheduled so as to assure adequate time for presentation and discussion of the papers.

The sessions do not begin until Tuesday, June 30, Monday being given over to numerous committee meetings. One of the features of the week is the symposium on X-Ray Crystallography and Radiography sponsored by Committee E-4 on Metallography through its sub-committee VI. This will take four sessions at which 12 papers, 6 on radiography and 6 on diffraction, will be presented by leading authorities, under the direction of Dr. R. F. Mehl, Carnegie Institute of Technology.

Other features include several papers on various phases of spectrographic analysis, with separate sessions devoted to non-ferrous metals, wire corrosion, fatigue and the effect of temperature on metals.

At the opening session on Tuesday, June 30, Dr. H. C. Parmelee, editor of *Engineering and Mining Journal*, will deliver an address on "Chemical Engineering and Its Relationship to the Work of the A.S.T.M." The president of the society, H. S. Vassar, will also present his annual address at this session.

The tenth Edgar Marburg lecture will be delivered Wedneday afternoon, July 1, by Dr. Arthur L. Day, director, geophysical laboratory, Carnegie Institute of Washington. His subject is "Developing American Glass" in which work he has played a leading part. At the same session the Charles B. Dudley Medal will be awarded to H. C. Mann, research engineer, Watertown Arsenal, for his paper on "The Relation Between the Tension Static and Dynamic Tests," presented at the 1935 annual meeting.

A. W. Demmler Promoted

A. W. Demmler has recently been appointed metallurgical engineer in the research and development department of the **Vanadium Corp. of America.** He continues his office in Bridgeville, Pa., where he has been located in various capacities for the past 13 years.

Following graduation from Pennsylvania State College, Mr. Demmler obtained his M.S. from Massachusetts Institute of Technology and continued his graduate studies at the Royal Technical University of Stockholm, Sweden as fellow in electrometallurgy of the American-Scandinavian Foundation. Subsequently, he taught this subject at Pennsylvania State College and then entered the metallurgical department of United Alloy Steel Corp. from which he came to his present connection.

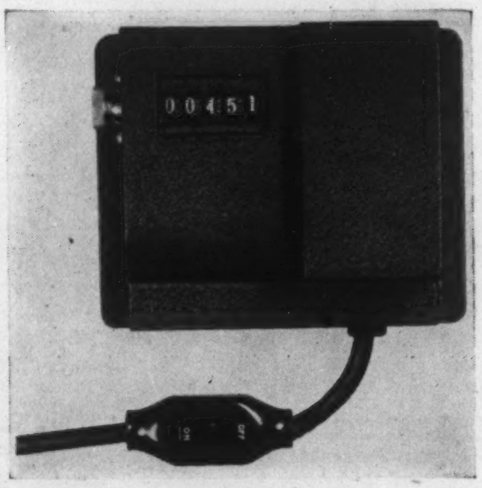
George P. Halliwell, formerly assistant professor of metallurgy at Carnegie Institute of Technology, has been appointed director of research at **H. Kramer & Co.**, Chicago, refiners of non-ferrous metal scrap and producers of brass ingots and non-ferrous alloys.

NEW EQUIPMENT AND MATERIALS

A Timing Instrument

The "Tymeter" is the result of many years of close association in the production of timing instruments for the industrial field and is the culmination of what is most accurate and applicable for use in the industries from a composite experience gained through intimate contact with their timing problems. Especially is the tymeter invaluable in precision timing, says the M. J. Stillman Co., 116 So. Michigan Ave., Chicago.

It is constructed to withstand constant and severe usage and is guaranteed for 5 years. Its application is wide and varied, but chiefly it will readily prove its worth in timing of industrial operations, setting piece work rates, establishing premium system, cost determination of manual or mechanical operations, viscosity testing, laboratory and research and in fact is claimed applicable in the entire gamut of industrial timing necessities where indisputable accuracy is a factor.



The tymeter operates with a sturdy synchronous motor specially constructed for this type of work and its power is obtained from 60-cycle, 110-volt alternating current. The case is of die cast aluminum with a black crackle finish. For the convenience of the operator, the starting and stopping switch will permit time to be taken out by stopping the machine and again starting without going back to zero. The knob on the left hand side is used for returning all figures to zero by pulling same out and turning ahead until all figures are cleared. The knob will then drop into a locked position.

Where it is desired to entirely obviate the human element in starting and stopping the tymeter, it is possible to furnish photo-electric-cell equipment in connection. This of course will require additional charges and estimates will be furnished on request after submission of the problem.

The instrument is furnished in three models. Model "T" operates in seconds and tenths of seconds and is shown in the illustration in actual size. The extreme right hand wheel registers tenths of seconds and the four remaining wheels register seconds up to and including 9999.9 sec.

Model "D" operates in the decimal system with the extreme right hand wheel registering hundredths of minutes, the second wheel from the right registering tenths of minutes and the remaining three wheels registering minutes up to and including 999.99 min. Model "H" operates in seconds and hundreths of seconds and is used for very fast and precise work and is applicable for races where records are to be established. The extreme right hand wheel registers hundreths of seconds and the remaining four wheels register seconds up to and including 9999.99 sec. It supersedes all other types of timing mechanism which are spring wound due to its accuracy and its use will quickly convince the operator of its superiority. All standard models are furnished for 60-cycle, 110-volt alternating current only. For 220-volt 60-cycle or for 50-cycle current, special models can be furnished at a small additional charge.

New High Temperature Steel

The Timken Steel & Tube Co., Canton, O., has announced a new steel designated as "Silmo," especially designed for applications where an economical combination of high-temperature strength and oxidation resistance is required. In the temperature range of 1000-1200 deg. F. the new steel is claimed to have about twice the strength of carbon steel and its oxidation resistance compares favorably with that of 4 to 6 per cent Cr-Mo steel.

This new steel may be used to replace carbon steel where greater safety is required and as a substitute for the standard carbon-molybdenum steel where oxidizing conditions are encountered. Indicated uses lie in the field of cracking furnace tubes, pipe still heater tubes, high-pressure boiler and superheater tubes, and tubing used in the manufacture of air heating equipment.

Complete physical data covering high-temperature tensile properties, Charpy value at elevated temperatures, heat embrittlement tests, creep strength, temperature-stress embrittlement tests, stability, and corrosion and oxidation resistance, together with curves showing the creep strength at various temperatures and the relation between creep strength and rate of creep at 800, 1000 and 1200 deg. F. are presented in a series of six looseleaf pages available on request to the Timken company.

Rubber Latex as a Protective Coating

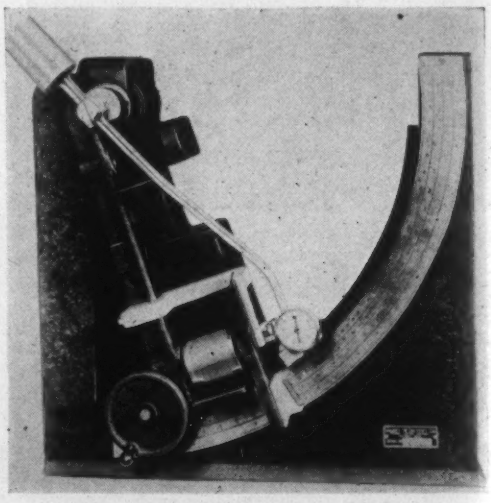
A new commercial use for rubber latex as a protective coating, easily applied and readily removed, for automobile bumpers, fenders and other articles to be shipped or stored, is announced by R. W. Albright, general manager of American Anode, Inc., Akron, Ohio. The new compounded material, known as "Protex," is now being employed by bumper and automotive manufacturers to cover metal parts. In some instances even entire automobiles have been coated for export shipment from the factory to the consumer.

Refrigerators and other articles with polished surfaces have also been successfully coated with "Protex" giving protection against abrasion, bumps and corrosion during transportation and storage. Outstanding properties are its ease of application, flexibility and resistance to chemical action, according to Anode company officials.

Deformation and Resilience Accessory for Sand Strength Machine

The "Deformation Tester" is a most useful accessory for the Universal Sand Strength Machine in that it adds materially to the value of the compression strength test, says the Harry W. Dietert Co., Detroit. The deformation test readings are multiplied by the compression test reading to obtain the sand resilience value which figure is used to determine whether the sand has good life or whether it is "short" and "brittle." Its net weight is 5 lbs., shipping weight, 10 lbs., length overall, 24 in., and capacity, 0 to 0.100 in.

The deformation test accessory consists of an aluminum arm pivoted on ground and sealed ball bearings at the fulcrum point of the pusher arm and weight of the strength machine. A special dial indicator, protected from dust, is mounted on the free end of the deformation tester arm. The stem of the indicator bears against the stud of the compression test head, while the body of the indicator is connected to the pusher arm of the strength machine through an automatic releasing arm which makes it possible to measure the amount that the sand specimen decreases in length or deforms at the instant that the sand specimen breaks. The maximum reading of the deformation indicator is shown by a red maximum reading hand.

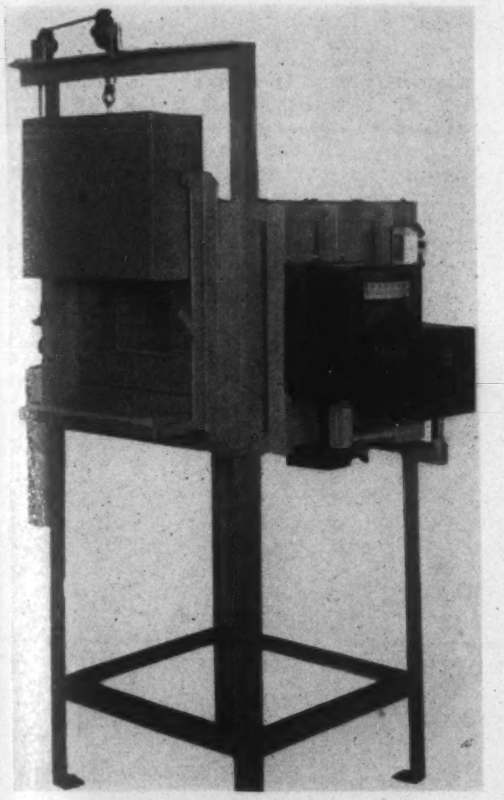


The deformation test requires very little extra effort on the part of the operator in that it is made at the same time that the compression test is made. The operator moves the arm of the deformation indicator to its lowest position and sets the reading hand of the indicator to zero. Molding sand, like other materials, may possess a satisfactory strength but the strength possessed is considerably limited, due to a property which may be termed "deformation." For example, when a material is brittle, then its load carrying power is very limited. Molding sand may become "short" or "brittle" though the strength is satisfactory.

A factor termed "Sand Resilience" takes into consideration both the strength and the deformation, and this adds much to the green sand strength test. Sand resilience indicates the amount of work required to break the sand. It is calculated by multiplying the green compression strength reading by the reading of the Deformation Indicator.

High Temperature Muffle Furnaces

To its line of industrial electric heat treating equipments, H. O. Swoboda, Inc., Pittsburgh, announces the recent addition of "FALCON" high temperature electric muffle furnaces. This furnace is suitable for operating temperatures up to 2300 deg. F. and is equipped with high temperature metallic heating elements mounted in the hearth, roof, side walls and rear of the furnace. The elements are of the wound type substantially supported in grooved refractories. The refractories are reversible for forming muffle chambers, or separate muffles can be supplied. Inside dimensions of the muffle are 9 in. wide x 6 in. high x 13 in. deep. Capacity of furnace, 6 kw. The refractories are backed by three layers of block type high temperature insulation.



The entire chamber together with heat insulation is enclosed in sheet metal casing. A steel frame door together with refractory charging shelf is provided on the furnace. The door is raised and lowered by means of hand cable and side counterweight. The door is provided with the same high temperature insulation as the furnace chamber. All connections for the heating elements are entirely enclosed within the furnace casing at the rear, so that no live current carrying parts are exposed.

Automatic temperature control equipment is mounted on and connected to the furnace. Furnaces are available in various chamber sizes and capacities as well as for 110, 220 or 440 volts, single or 3-phase; type of control optional.

A New Salt Bath Furnace

The advantages of molten salt baths compared with other types of heat treating furnaces have long been recognized by metallurgists. These inherent advantages, such as the prevention of scaling and oxidation of the work, more rapid heating, etc., are cost reducing factors which lend themselves to most heat treating operations. Moreover, the concentrated efforts and scientific research of salt manufacturers in the past decade have made available a large variety of salt mixtures designed for every form of liquid heat treating operation, such as case-hardening, re-heating, annealing, tempering, etc. But, in spite of these inherent properties, molten salt baths have not attained the wide-spread use they so justly deserve. This is claimed as entirely due to the shortcomings of furnace designs. Fuel-fired pot furnaces, because they are externally fired, operate at an extremely low efficiency and entail very high pot maintenance costs. These and other limitations of existing pot furnace designs led Ajax engineers to investigate the possibilities of developing an electrically heated salt bath, specifically designed to meet the severe metallurgical requirements of liquid heat treating operations encountered in cyaniding, hardening, annealing, etc.

The "Ajax-Hultgren Salt Bath Furnace" is the result of this pioneer work. Results being obtained in commercial operation justify the claim of the Ajax Electric Co., Philadelphia, that this salt bath furnace has not only eliminated definite disadvantages in other furnaces but possesses advantages hitherto unknown. A complete description of this furnace is found in the first article in this issue.

"Metal-Bord"

The American Nickeloid Co., Peru, Ill., announces a new development of considerable importance in the metal field. It is the replacement of metal volume and weight by a non-metallic substance. This is accomplished by adhering thin sheets of pre-finished metal to cardboard or other backing material. The metallic appearance of the sheet is retained, but the body of the sheet is largely the non-metallic backing. The adhering cement will remain plastic and has, therefore, practically permanent adherence. It remains flexible.

The advantage of such a composited material lies in the lower cost and saving in weight, which are two important factors in most products. Any thickness of metal can be used and composited to just about any type and thickness of backing. This new product is called "Metal-Bord."

Showing an HDT-10187-C Atmosphere Controlled Box Type Furnace.

For
Heat Treating

HIGH SPEED
STEEL

use

HEVI DUTY
High Temperature Furnaces

WITH

Alloy 10 Metallic Electric Resistors
Furnace Temperatures to 2400° F.
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HEVI DUTY ELECTRIC CO.

MILWAUKEE HEVI DUTY WISCONSIN

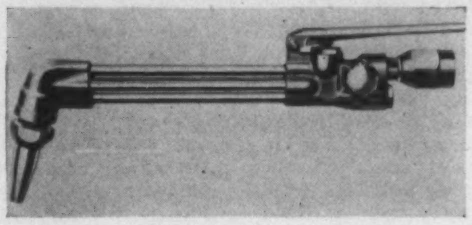
HEAT TREATING FURNACES
« ELECTRIC EXCLUSIVELY »

An Oxy-Acetylene Cutting Attachment

A new oxy-acetylene cutting attachment known as the "Oxweld Type CW-22" has been announced recently by The Linde Air Products Co., 30 East 42nd St., New York. This cutting attachment incorporates features of design and possesses a range and quality of performance, which permit it to handle light sheet metal as well as all but the heaviest work at speeds and efficiency equal to those of the full size cutting blowpipe. The attachment operates on low-pressure or medium-pressure acetylene, with equally satisfactory results. Severe field tests have proved its capacity, stability and endurance under all conditions.

The Type CW-22 cutting attachment can be used on either the Oxweld Type W-17 or W-22 welding blowpipe handle, thereby greatly extending the utility of these two popular blowpipes.

Sturdy, smooth operation at all times and all pressures is given by the new streamline injector and by the improved type cutting valve, with removable seat, centralized under the cutting lever. The mixed gas passage is formed by three Ambrac tubes. The length, and four 90-deg. changes of direction, afforded by this type of construction give exceptional flashback resistance. The body and head of the CW-22 are designed to combine strength and lightness, the body being of pressure-forged bronze while the head is a manganese bronze forging.

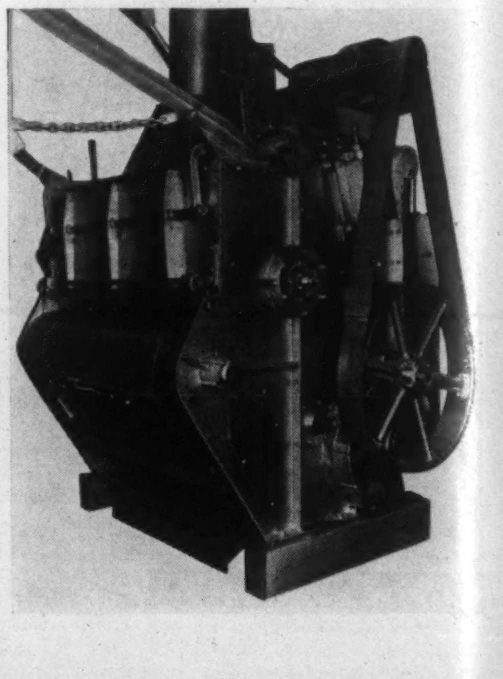


A Small Wheelabrator Tum-Blast

A new small "Wheelabrator" unit, designed especially for use in foundries, shops and plants having a limited production, is announced by The American Foundry Equipment Co., 555 Byrkit Street, Mishawaka, Ind. The new wheelabrator unit is installed in a new size tum-blast mill. While smaller in size, this mill has all the desirable features which are responsible for the international popularity of the larger Wheelabrator Tum-Blast.

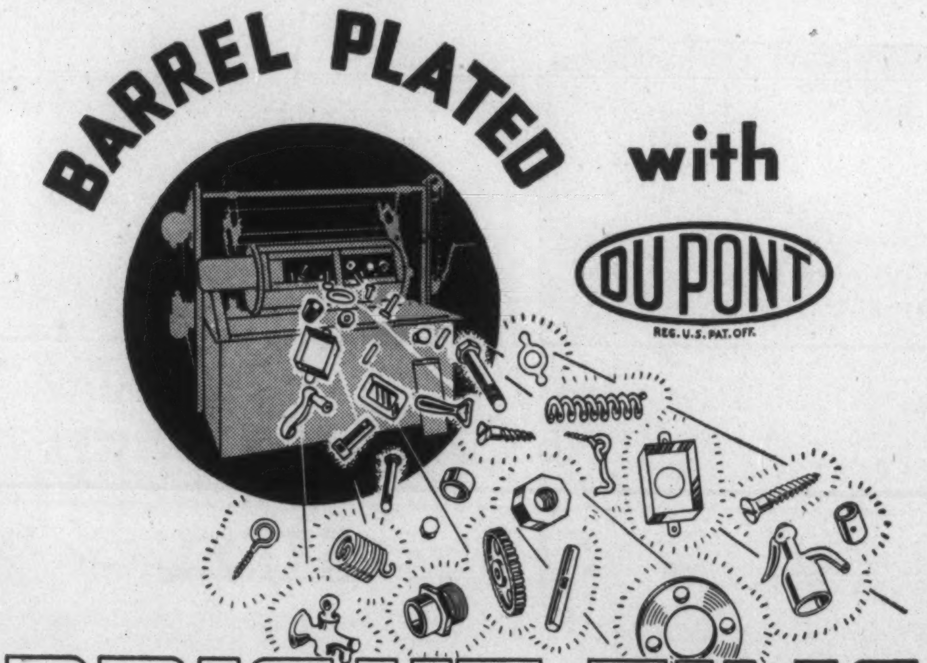
Material to be cleaned is loaded directly onto the apron conveyor. When the mechanism is set in operation, the action of the conveyor apron cascades the individual castings, over and over, directly under the blasting area, assuring complete coverage at all times. In unloading, the movement of the conveyor is reversed, allowing cleaned products to spill into waiting receptacles under the machine.

Centrifugal force replaces compressed air as a driving agent in whipping abrasive onto the work to be cleaned in the wheelabrator. Abrasive is fed by gravity from an overhead storage bin in the center of the wheelabrator. After blasting it drops through holes in the conveyor plates into a hopper below where refuse is automatically screened out. Cleaned abrasive drops into the boot of a bucket elevator and is lifted to an overhead storage hopper for re-use. Steel grit or shot may be used over and over. Dust is carried out of the tum-blast by the American dustube collector operated in conjunction with the machine. The abrasive cycle used in wheelabrating is constant until the machine is shut off for loading or unloading.



Many new developments are incorporated in the construction of this 27 x 36 in. wheelabrator unit. The door is counterweighted for easy operation. It swings up and provides an unobstructed opening for loading and unloading. It is completely equipped with dust seals. The apron conveyor can be provided with either overlap or flat type slats, depending on the type of material to be cleaned. Both slats are furnished with heavy-duty reinforcing channels.

Having an operating load capacity of 5 cu. ft., the 27 x 36 in. Wheelabrator Tum-Blast answers the need of manufacturers with a limited production for automatic cleaning equipment which is both economical in operation and maintenance.



BARREL PLATED with DU PONT REG. U.S. PAT. OFF.

BRIGHT ZINC

NUTS and bolts, hasps, hooks, springs, machined parts, stampings . . . and other steel parts are now barrel-plated commercially with du Pont Bright Zinc. Bright dipping unnecessary, although extra high luster can be obtained after plating by a bright dip in bulk and in baskets. Excellent results. Low costs, for no expensive addition agents are used. Solution is self-maintaining except for dragout. No metal salt replenishment.

This *dependable* Bright Zinc process is giving consistently good commercial results in barrel plating, full- and semi-automatic units. It is by far the easiest plating solution to control.

Write for more details

E. I. DU PONT DE NEMOURS & COMPANY, Inc.
Wilmington, Delaware

A Hydrogen Brazing Furnace

An electrically-operated hydrogen brazing furnace designed especially for the tipping of sintered carbide cutting tools is announced by the Firthite Division of the Firth-Sterling Steel Co., McKeesport, Pa. Known as the "Firth Braze-Rite Furnace," it provides for a simplified and improved method of brazing carbide blanks to steel shanks insuring a positive, permanent braze. With the furnace, tools of a wide variety can be brazed in much less time than has heretofore been required since heat is localized at the end of the tool on which the carbide blank is to be mounted, eliminating the necessity of heating the entire shank.

The furnace is provided with two separate mufflers, each of 2-ii. capacity. Those mufflers are made of a high heat-resisting alloy, developed to withstand brazing temperatures and which, in turn, will offer exceptionally long life. Tools varying in size from small bits up to those having 1½-in. sq. shanks can be accommodated. Either 110-220 volts A.C. or D.C. can be used for operation. When A.C. is employed a tap transformer is supplied and, when D.C. is used, the control is through a rheostat. A direct-reading pyrometer is mounted at the rear of the furnace.

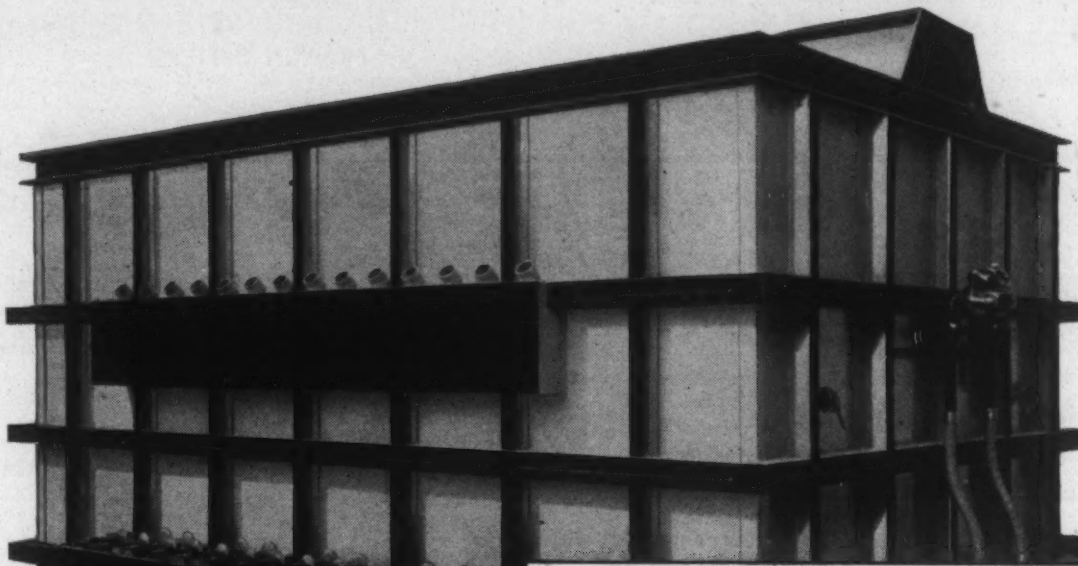
The furnace can be brought up to brazing temperature in a very few minutes. On the other hand, when the furnace is to be shut down, it is not necessary to make gradual current reductions as with former type hydrogen furnaces. This feature makes the furnace exceptionally suited for the brazing of small quantities of tools, in addition to continuous operation for larger quantities.

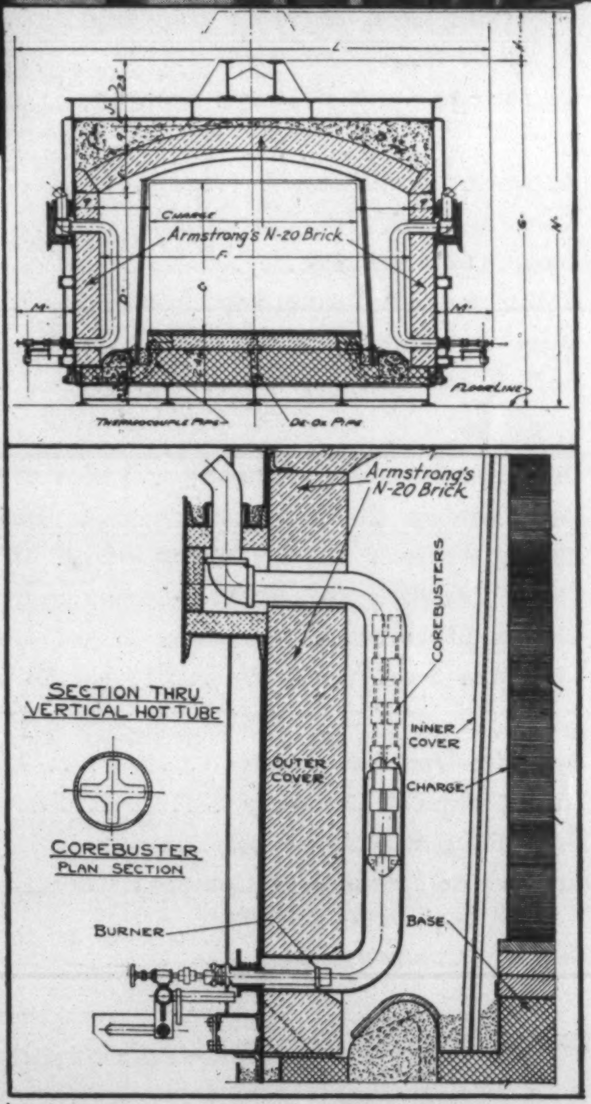
Brazing is carried out in a hydrogen atmosphere to prevent oxidation of the carbide tip and shanks, as well as the brazing material. Hydrogen is admitted through openings at the rear of each muffle. The amount of hydrogen is controlled by valves located at the rear of the furnace. A manifold is provided for connection of the hydrogen supply.

Economical operation of the furnace is claimed an outstanding feature since very little current is required to maintain a correct brazing temperature. A single tank of hydrogen will provide for several days' operation under normal use. The muffles, which can be quickly interchanged, will offer several hundred hours' life under ordinary conditions. The heating elements, likewise, will provide exceptionally long use.

Complete tools required for brazing are furnished, including tongs, shears, scraper and tip presser. In addition, a quantity of Firth Braze-Rite flux and copper is supplied, suitable for the brazing of a large quantity of tools.

A metal-top table is furnished optionally, although the furnace can be mounted on a bench if so desired. The table when furnished measures 21 x 21 in.





FROM TOP TO BOTTOM...END TO END

– a uniform distribution of heat

Armstrong's N-20 Brick makes an important contribution to the efficiency of this Lee Wilson Annealing Cover

HERE'S a new annealing cover that has attracted the attention of production men throughout the heat treating field. It's made by Lee Wilson Engineering Co. of Cleveland, Ohio, for annealing sheets, coils, or tin plate.

Vertical tube design and Armstrong's N-20 Insulating Brick are the reasons for its efficiency, according to Mr. Wilson. They make possible larger hourly production, lower fuel costs, and "a more accurate and efficient distribution of heat to the charge—."

Today, more and more furnace builders are using Armstrong's High Temperature Insulation in their equipment. In addition to Armstrong's N-20 Insulating Brick, the Armstrong Line includes insulating brick and insulating fire brick for a complete range of temperatures and uses. We'd like to send you descriptive literature and samples of these efficient brick. Just write Armstrong Cork Products Co., Building Materials Division, 982 Concord St., Lancaster, Pa.

LEE WILSON ANNEALING COVER *of vertical tube design which makes possible even heating throughout the charge. Note the use of Armstrong's N-20 Insulating Brick (shown in diagrams) to assure this uniform temperature and low fuel cost. The fuel consumption per ton of sheets "ranges from 750 cu. ft. of natural gas per ton for low temperature annealing to 1250 cu. ft. for high temperature annealing."*

Armstrong's

HIGH TEMPERATURE INSULATION

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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Mining Revival at Granya—Research on Ore Treatment Brightens Outlook. G. B. O'Malley. *Chemical Engineering & Mining Review,* Vol. 28, Feb. 8, 1936, pages 144-146. By an extension of the present plant (battery crushing and tabling treatment) to include grinding and amalgamation or straking of the concentrates and cyanidation of the table tailings an immediate recovery of 75% of the Au can be made. Direct cyanidation of the ore at —200 mesh (without roasting) yields 90% of the Au with a cyanide consumption of 5 lbs., a figure varying with the Cu content. It may be possible to eliminate the roasting operation. WHB (1)

■ 1a. Crushing, Grinding & Plant Handling ■

Size of Gold Grains in Copper Ore (3rd International Mines, Urals) S. I. Mitrofanov. *Tzvetnuie Metallui,* No. 4, May 1935, pages 54-55. In dressing Cu-Zn ores of the Mines the sands from classifiers contain grains of Au up to 0.5 mm. in largest dimension, and in the tailings up to 0.1 mm. Finer Au particles are also found in the concentrates. Suggests that Au bearing materials at various stages of ore concentration may be removed, that part of the Au from tailings may be removed mechanically, and finer Au particles by additional flotation operation. BND (1a)

The Theory of Crushing. Fred C. Bond. *Mines Magazine,* Vol. 25, June 1935, pages 11-13, 30. The lack of a complete exposition of the theory which governs crushing and grinding is pointed out and a mathematical approach is attempted. WH (1a)

■ 1c. Flotation ■

Principles of Flotation, IV—An Experimental Study of Influence of Sodium Sulfide, Alkalis and Copper Sulfate on Effect of Xanthates at Mineral Surfaces. Ian William Wark & Alwyn Birchmore Cox. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 659, Jan. 1936, 20 pages. The influence of Na_2S on contact induced by xanthate between air bubble and the minerals anglesite, cerussite, galena, sphalerite, pyrite, chalcopyrite, bornite, covellite and chalcocite was investigated. Na_2S is a depressant for the sulphide minerals. Concentration of Na_2S necessary to prevent contact is a function of pH value. The (HS^-) ion is the effective depressant and there is a critical value for each mineral. This value is not greatly influenced by the xanthate concentration. Cu_2SO_4 influences the effect of Na_2S on galena and chalcopyrite, probably removing it from solution as a precipitate of CuS. Cu_2SO_4 must be stoichiometrically in excess of the sulphide if it is to activate sphalerite. The combined influence of Cu_2SO_4 and Na_2S on pyrite is exceedingly complex. The concentration of K ethyl xanthate necessary to induce contact between an air bubble and anglesite and cerussite respectively was investigated as a function of the pH. Anglesite responds most readily between pH 9 and 11, cerussite at pH below 9. Na_2CO_3 increases the concentration of ethyl xanthate necessary to induce a response at surfaces of anglesite and cerussite. Controlled concentrations of Na_2S activate anglesite and cerussite so that they respond to lower concentrations of xanthate, but excess of sulphide prevents a response. Cerussite responds more readily to xanthate after an initial treatment with Na_2S. It is argued that the activation is due to the formation of a surface film of PbS. There is a corresponding blackening of the surface. The response of anglesite and cerussite to amyl xanthate is less influenced by Na_2S than their response to ethyl xanthate. Na_3PO_4 may be substituted for Na_2S as an activator for anglesite and cerussite. Sulphide is consumed in preference to xanthate by these two minerals. It is difficult to control the sulphide concentration in flotation-plant circuits because of the volatility of H_2S. 11 references. JLG (1c)

Froth Flotation of Southern Barite Ores. R. G. O'Meara & G. D. Coe. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 678, Feb. 1936, 6 pages. Laboratory experiments indicated that barite ores could be improved by flotation, the $BaSO_4$ in one ore being raised from 77.2 to 98.1%. For ores not containing fluorite Na_2SiO_3, Na oleate and oleic acid were used. For ores with fluorite Na_2SiO_3 and Emulsol X_1 were found satisfactory. JLG (1c)

Notes on the Balimbing Mine, West Coast of Sumatra. D. W. J. Grey. *Bulletin of the Institution of Mining & Metallurgy,* No. 375, Dec. 1935, pages 1-48. The evolution of the present flow sheet is described in detail. An old tabling and cyaniding plant was scrapped in favor of flotation. Use of a blanket strake before the classifier reduced reagent consumption to Pbac 0.93, Na_2S 0.31, Bu xanthate 0.19, Aerofloat 15 0.14, soda ash 0.90 lb./ton. In August, 1934, treating an ore average 2.79 dwt./ton, 32.6% of the Au was recovered on blankets; flotation recovered 93.6% of the Au from an impoverished head (1.88 dwt.) for an overall recovery of 95.7%. AHE (1c)

Concentration of Molybdenum Ores. B. G. Titov. *Redkie Metallui,* Vol. 4, Sept.-Oct. 1935, pages 15-28. In Russian. Partially oxidized sulphide ores containing 0.42-0.48% Mo were concentrated by flotation. About 98% of the sulphide Mo was recovered in a concentrate containing 52.50% Mo. Reflotation of the tailings recovered the oxidized Mo in a concentrate containing 2.25% Mo. Overall extraction was about 80%. HWR (1c)

Milling Developments at the Benguet Consolidated Plant. J. M. Morris. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 675, Feb. 1936, 13 pages. Tells of the introduction of flotation for treatment of Au ores at a mill in the Philippine Islands. JLG (1c)

Flotation of Molybdenum Ore of the Tura Deposit (Ural) S. I. Mitrofanov. *Tzvetnuie Metallui,* No. 4, May 1935, pages 56-58. The molybdenite ores of the district contain 0.06% Mo. Concentrates obtained in laboratory contained 44-47% Mo (75% MoS_2), and 80-90% recovery was realized. For flotation ores are ground to 200 mesh (75%) and ordinary reagents, xanthate and pine tar, are used. BND (1c)

Obtaining Barite Products from Lead and Zinc Flotation Tailings at the Salair Ore Dressing Plant. A. K. Lebedev. *Tzvetnuie Metallui,* No. 4, May 1935, pages 30-53. The Salair polymetallic ores contain 1% Pb, 7% Zn, 2.7% Fe and 45 to 50% $BaSO_4$. At the present the Zn and Pb are separated by selective flotation, and since 1934 the barite is also recovered by flotation from the tailings. A detailed description of the ore dressing scheme for the recovery of Zn, Pb and barite is given. The recovery of barite is 90% of the amount in the concentrate, or 60% of the material in the ore. The purity of the barite is 92%. Suggestions are given for increasing the recovery of barite to 75% of the quantity present in the ore. BND (1c)

The Effect of the Concentration of Hydrogen Ion and Various Chemicals on the Flotation of Chalcopyrite. Gaichi Yamada, Jiro Wakasugi & Kiyoji Naganuma. *Suiyokwai-shi,* Vol. 8, Mar. 30, 1936, pages 943-950. The Ashio chalcopyrite was finely crushed to —65 mesh and the finest powder, —200 mesh, was removed. Experiments were carried out on the flotation of chalcopyrite in solutions of various pH applying a given amount of flotation reagent, i.e., camphor, white oil and potassium ethyl-xanthate, and adding a small amount of chemicals, e.g., $CuSO_4$, KCN, tannin, NaCl. The floatability of chalcopyrite is about 96%, in a solution of pH-value lower than 10.42. It suddenly decreases from 96 to 84.4 in the range of pH-value from 10.42 to 11.76. With 100 g. and 500 g. of KCN per ton of ore in strong alkaline solution, it is found that the floatability of chalcopyrite gradually decreases, but in the case of 893 g. of KCN per ton of ore it suddenly decreases at pH-value 7.8. HN (1c)

The New Lead and Zinc Flotation Sections of the Concentrator of Broken Hill South Limited. T. A. Read. *Proceedings Australasian Institute of Mining & Metallurgy,* No. 98, June 30, 1935, pages 305-348. The new flotation plant at the South Mine, Broken Hill, is described in detail and metallurgical results are given. AHE (1c)

The Separation of Cobalt and Copper Minerals by Selective Flotation. F. C. Bosqui. *South African Mining & Engineering Journal,* Vol. 46, Part II, Jan. 18, 1936, pages 661-662; (abstract) *Chemical Trade Journal & Chemical Engineer,* Vol. 98, Feb. 14, 1936, page 130. About 75% of the Co, occurring as carrollite ($CuCo_2S_4$) at Nkana, is recovered in the flotation of the Cu. In the reverberatory it remains in the Cu-Fe-S matte. Under the intense oxidizing conditions in the converter, the Co reacts as does the Fe and goes into the slag as the double silicate of Co and Fe. After granulation of the slag, Co is recovered in an electric-arc furnace. From a concentrate containing 2.5% Co, a slag is produced analyzing Co 15.0, Fe 33.0, Cu 2.90 and SiO_2 25.0%. This gives an electric-furnace alloy analyzing Co 55.3, Fe 33.5, Cu 10.40 and SiO_2 0.5%. In order to concentrate the Co, the bulk concentrates, assaying Cu 50, Co 2.0 and SiO_2 7.5%, after filtering and washing were repulped and floated in a cyanide circuit to give a Cu concentrate assaying Cu 56, Co 0.8 and SiO_2 4.0% and a Co tailing. After regrinding, the tailing is refloated in a fresh-water circuit to give a Co concentrate analyzing Cu 47, Co 4.35 and SiO_2 6.0%, containing 30% of the Cu and 70% of the Co, and a tailing assaying Cu 15, Co 1.6 and SiO_2 37.80%, which is returned to the mill. MS + AHE (1c)

Mineral Industries Survey of the United States. Idaho, Shoshone County, Coeur d'Alene District. The Silver Belt and the Sunshine Mine of the Coeur d'Alene District. C. E. Julihn & F. W. Horton. *United States Bureau of Mines, Information Circular* No. 6876, Feb. 1936, 16 pages. Includes brief descriptions of the milling methods at Sunshine and Crescent mines. AHE (1c)

Flotation Processes for the Separation of Mineral Concentrates from Metalliferous Ores. D. C. Gilder. *Journal Institution of Engineers Australia,* Vol. 8, Feb. 1936, pages 67-68. Notes applying to the treatment of the Au bearing ores of western Australia. WHB (1c)

Milling Methods and Costs at Eustis Concentrator of the Consolidated Copper and Sulphur Company. H. A. Baxter & Fred W. Stone. *Transactions, Canadian Institute of Mining & Metallurgy,* 1936 (in *Canadian Mining & Metallurgical Bulletin* No. 286, Feb.) pages 86-97. The ore analyzes Cu 3.71, Fe 30.00, S 34.90, SiO_2 7.82, and Al_2O_3 2.45%. Using CaO 2.520 lbs./ton and NaCN 0.349 lb. in the ball mills and floating with amyl xanthate 0.184 and pine oil 0.386 lb. fed to the classifier overflow gave a Cu concentrate averaging 25.623% Cu with 93.77% recovery. The tailings go to the Fe circuit where the pyrite is reactivated with $CuSO_4$ 1.049, Na_2S 0.556 and soda ash 4.291 lbs./ton. Using butyl xanthate 0.422 lb., 70.43% of the Fe is recovered. AHE (1c)

Cyanidation Then Flotation—New Method Adopted at Kalgoorli. Charles E. Blackett. *Chemical Engineering & Mining Review,* Vol. 28, Feb. 8, 1936, pages 133-136. At the Kalgurli Ore Treatment Co. Ltd. plant at Kalgoorli, W. A. a combination method of precyanidation followed by flotation, roasting and cyanidation of concentrates has been selected. A flow sheet is shown and the various steps outlined. WHB (1c)

The Action of Potassium n-Amyl Xanthate on Chalcocite. A. M. Gaudin & Reinhardt Schuhmann. *Journal of Physical Chemistry,* Vol. 40, Feb. 1936, pages 257-296. In the short time treatment of Cu_2S with xanthate, the xanthate abstracted by the mineral may be accounted for as cuprous xanthate and as an entity unleachable with ordinary solvents. The formation of these products occurs practically simultaneously, although with larger quantities of xanthate the reaction to form cuprous xanthate slows up with increase in quantity of cuprous xanthate on the mineral. In the long time treatment of Cu_2S with xanthate, leachable products other than cuprous xanthate are formed relatively slowly. All the K of the K xanthate remains in the solution. Hydroxide, carbonate, sulphate, and reducing ions $(S_mO_n)^{--}$ are thrown into the solution in a total amount mathematically equivalent to the xanthate abstracted from the solution. Leaching off the leachable products from xanthate-treated chalcocite has no appreciable effect on the flotative properties of the Cu_2S. Pyridine extracts cuprous xanthate from xanthate-treated and leached Cu_2S, i.e. from Cu_2S having the "unleachable" film. The "unleachable" product increases with increase in xanthate added, approaching a maximum in a manner suggestive of adsorption. The maximum amount of unleachable xanthate attainable with a given sample of Cu_2S corresponds to a complete mono-molecular film on the Cu_2S. If the quantity of xanthate just sufficient for effective flotation is added, it may be almost completely accounted for as the unleachable product. Only a relatively small fraction of the monomolecular film of "unleachable" is necessary for efficient flotation. The fraction of the surface filmed determines the dryness of the mineralized froth. Increasing the surface of the mineral by longer grinding increases the unleachable portion and decreases the cuprous xanthate portion of the reaction products. The unleachable water-repellent film may be produced by the adsorption of cuprous xanthate from benzene solution by the Cu_2S. There is an essential difference between the collecting actions of xanthate on Cu_2S and malachite respectively. An unleachable water-repellent film is not formed on $CuCo_3.Cu(OH)_2$ by xanthate. EF (1c)

■ 1e. Amalgamation, Cyanidation & Leaching ■

A Study of the Occurrence and Amenability to Leaching of the Phosphorus Compounds in Some Red Iron Ores of Alabama. Ellis S. Hertzog. *United States Bureau of Mines, Report of Investigations* No. 3294, Dec. 1935, 9 pages. Most of the P in these ores occurs as $Ca_3(PO_4)_2$ mixed with small quantities of ferrous, ferric and Al phosphates. Thoroughly leached outcrop ores usually are low in P compared with unleached ores. Acid solutions are the best solvents for $Ca_3(PO_4)_2$. The acid consumption increases with increased $CaCO_3$ content. The P in ores in which the $CaCO_3$ content is small is not removed by weak acid solutions. $FePO_4$ is removed by strong acid solutions, which also dissolves appreciable amounts of the Fe ore. A cheap reagent is essential. It must not introduce any objectionable element into the ore. The removal of P from the red Fe ores of Ala. by leaching does not appear to be commercially feasible. AHE (1e)

Physical Characteristics of Gold Lost in Tailings. R. E. Head. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 674, Feb. 1936, 9 pages. Au in tailings was studied microscopically and by microchemical methods. Most of the Au particles are covered with a film, while the particles in the concentrate are bright. The film may be magnetic and usually contains Fe. All particles are rough and the film may be a tarnish or a slime coating. The response of pyritic ores to cyanidation depends on the porosity of the pyrite rather than on the brightness of the Au. Several possible methods for recovering Au are suggested. JLG (1e)

Effect of Lime on Cyanidation. W. G. Clarke. *Chemical Engineering & Mining Review,* Vol. 28, Jan. 8, 1936, pages 99-100. An investigation of tailings from the Beryl mine, Kemdip, W.A., which contained oxidized Cu minerals, but are free from Pb compounds is reviewed briefly. Some of the tailings were roasted for 3 hrs. in a wood fire muffle furnace at a gradually increasing temperature to 650° C. Loss during roasting was 5.3% and the assay value of the calcine was 6.6 dwt. Au/ton. Cyanidation tests were conducted on unground calcine and calcine after grinding wet in pebble mills to 81% — 200-mesh. A pronounced and progressive decrease in Au extraction results with increased lime alkalinity in the pregnant solutions. The amount of Cu in the pregnant solutions is low compared with tests on the cyanidation of raw tailings and the consumption of cyanide is not excessive. When the pregnant solution contains no free alkali the cyanide consumption is much higher and the balance is exceedingly sensitive. Cu and Pb apparently play no vital part in preventing solution of the Au. WHB (1e)

Electrocapillary Amalgamation. Osborn Cutler Shepard. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 676, Feb. 1936, 10 pages. As the negative potential of Hg increases the surface tension first increases and then decreases.' Experiments proved that as this potential was increased the ability to amalgamate Au particles decreased and then increased greatly. This is due to changes in surface tension of Hg. Na in the amalgam acts to produce negative potential and therefore aids amalgamation. Tests with ores washed over amalgamated plates with and without the plates being at a potential showed that for certain potentials the proportion of the Au in the ore recovered was increased. With too high a potential the amalgam tended to hold pyrite and become ineffective. Well water high in salts could not be used successfully with electrocapillary amalgamation because a white deposit was formed on the amalgam. JLG (1e)

Leaching Alunite with Sulphuric Acid. L. C. Pan. *Chemical Industry,* China, Vol. 10, Jan. 1935, pages 35-42. In Chinese. The best strength of H_2SO_4 for leaching alunite calcined at 500° C. was found to be about 15% by weight. Little advantage was gained by heating the leaching solution even to 100° C. The yield of alum by crystallization, however, was found to be greatest when acidity was minimum. Size of alum crystals formed was found to be minimum from solution containing 4.7% H_2SO_4. The sizes were about the same from 0.133 N H_2SO_4 as from 3 N H_2SO_4, but larger as the acidity was further increased. LCP (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

■ 2a. Non-Ferrous ■

Increased Output in the Mining Industries by Better Utilization of Existing Sources (Leistungssteigerung im Bergbau durch bessere Ausnützung der zur Verfügung stehenden Hilfsquellen) Fr. Saueressig. *Montanistische Rundschau,* Vol. 28, Apr. 1, 1936, 3 pages. Discusses the possibilities of increasing metallurgical recoveries by extracting metal values from old slag dumps and from accumulations of low grade ores and tailings, by more efficient handling of waste gases and by treatment of flue dusts, purification residues, electrolytic slimes, and similar metallurgical byproducts. Proper methods of briquetting, sintering and agglomeration facilitate the treatment of such materials. Addition of suitable fluxes during these operations makes the subsequent smelting processes more efficient. BHS (2a)

■ 2b. Ferrous ■

Some Engineering Aspects of the First Report of the Blast Furnace Practice Sub-Committee. Thomas B. Mackenzie. *Journal West of Scotland Iron & Steel Institute,* Vol. 43, Part 2, Nov. 1935, pages 19-40. Pertinent engineering data are given for each of 18 basic practice furnaces, 13 hematite practice furnaces, and 14 foundry practice furnaces. One furnace is operated by each practice. When making foundry Fe its output is 95%, and when making hematitic Fe is 93.3% of the output when making basic Fe. The coke consumption for foundry Fe is 110.1% and for hematite Fe is 115.5% of that for basic Fe. The coke consumption/ft.^{2} of hearth is $25 - 0.06D^2$ for basic practice, $25 - 0.067D^2$ for hematite practice, and $28 - 0.052D^2$ for foundry practice in which D is the hearth diam. in ft. Description of the equipment of the basic furnaces includes hot blast stoves; means of cooling the bosh wall, of charging the furnace, of providing the blast; and the volume of blast. Formulas that represent British practice relate the important furnace dimensions to the hearth diam. and to the tons/hr. production. FGN (2b)

Progress at the Blast Furnace in '35. A. J. Boynton. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 55-56. No outstanding innovations in construction or operation took place. Changes have been chiefly further adoption and increased use of methods and apparatus already known. Among changes proposed to furnace itself is so-called Venturi top. Improved bell construction consists of a horizontal sectional cast-steel spider carried by the bell rod and surmounted by a frustum of a cone made of plates and angles. Increasing attention continues to be paid to preparation of raw materials and to application of instruments. Much interest is being shown in use of blast-furnace gas for metallurgical purposes. MS (2b)

Some Blast Furnace Problems for '36. Wm. A. Haven. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 43-46. Means must be found for duplicating at full blast the results obtained with slow blowing in keeping down coke consumption and flue-dust losses. High blast temperatures, which aid in better coke practice, may be obtained by installation of new stove linings. With clean gas there is need for a refractory for the top courses of stove checkers, which is inert to alkaline dust at the prevailing temperatures. To reduce flue-dust losses, tops have been enlarged, but results have not been up to expectations, due to poor distribution of stock under the large bell. Remedy for this condition will require rather radical departures from present designs or equipment. Among proposed improvements are elimination of large bell and filling stock up into hopper; and division of large bell into 2 concentric parts, operable as a unit as a bell of large diam., or singly, using inner section as a bell of small diam. and other section as a deflector or auxiliary stock-line. MS (2b)

Relative Desulfurizing Power of Blast-Furnace Slags. W. F. Holbrook & T. L. Joseph. *Metals Technology,* Feb. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 690, 19 pages. A laboratory method was devised for determining the relative desulphurizing powers of slags of varying composition. Data and diagrams are presented for 1500° C. and for blast-furnace slags containing up to 10% Mg. No simple relationship was found by which composition as designated by the term "basicity" could be compared with S removal. To relate basicity and desulphurization MgO cannot be combined with CaO as total bases, nor can Al_2O_3 be combined with SiO_2 as total acids. Moreover, Al_2O_3 cannot be ignored in computing basicity. Each oxide has its own effect on desulphurization, and the degree of the effect is not constant for all ranges of composition. MgO was slightly deleterious to desulphurization of acid slags. The effect becomes increasingly undesirable as basicity is increased to that of slags of average composition. The presence of MgO is decidedly favorable to desulphurization in the more basic slags. Evolution of CO accompanying desulphurization probably has an important role in the over-all process. It retards the descent of falling metal drops and carries CaS and globules of metal away from the bath interface and into the slag, in both instances contributing to the effectiveness of the reaction. 8 references. JLG (2b)

Beneficiation of Low-Grade Ores Will Prolong Life of Mesabi Range. E. W. Davis. *Iron Age,* Vol. 136, Nov. 14, 1935, pages 30-31, 41. **Ore, Furnace Technique Must Develop Together.** *Steel,* Vol. 97, Sept. 30, 1935, page 48. Abstract of paper read before the Chicago convention of the western division of American Mining Congress. Discusses the application of Fe ore beneficiation to blast furnace practice. Future reserves of the Mesabi Range are low-grade ores, and they must be utilized for the manufacture of steel at a cost which will compare favorably with cost of producing steel from high-grade ores. Before low-grade ores may be used not only mining and beneficiation operations but smelting and refining operations should be improved. Gives present cost of agglomerating fine Fe concentrate and the effect of increase in future taxation on the cost. MS + VSP (2b)

3. MELTING, REFINING AND CASTING

Practical Metallurgy. I. Melting and Casting (Praktische Metallkunde. I. Schmelzen und Giessen) Georg Sachs. Julius Springer Verlag, Berlin, 1935. Cloth, 6¾ x 10 inches, 272 pages. Price 22.50 RM.

Most of the assembled metal products on the market contain castings of one sort or another. Sand, permanent mold, die castings, etc. are most frequently used. They must be free from blow holes, and by having good physical properties, give as few rejects as possible. Although the art of making castings is very old, the theoretical knowledge of the flow of metals, gating, etc. is very limited. Practical experience in many cases has to fill the gap.

This book tries in a systematic way to explain many practical questions which confront engineers and casting superintendents, referring for the greater part to non-ferrous metals.

The writer has had many years of theoretical and practical experience in the field of non-ferrous metals and due to this, the data and information compiled in this volume are very valuable. The chapter on gases in metals and the influence of slight impurities on the physical and chemical properties of metals and alloys is of special interest. Many chapters are too general and too short to be of great value, as for example the chapter on die castings.

In general it may be stated that the attempt to handle so many different problems in 300 pages was successful. Fred J. Tobias (3) -B-

Process Charts Reduce Costs. Albert J. Saute. *Foundry,* Vol. 64, Feb. 1936, pages 31, 78. Discusses the advantages of process charts in the foundry and the method of making them. Gives several examples. VSP (3)

Mould and Core Materials at Elevated Temperatures. *Foundry Trade Journal,* Vol. 53, Dec. 26, 1935, pages 469, 470 and 466. Discussion on Hudson's paper, *Foundry Trade Journal,* Dec. 5, 1935, pages 411-416. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 176L/2. AIK (3)

Molding Sand Testing Apparatus. H. W. Dietert. *Sands, Clays & Minerals,* Vol. 2, Apr. 1936, pages 161-166. Methods and apparatus for testing strength, moisture, fineness, permeability, flowing properties, sintering point and deformation are described. Ha (3)

Assemble Flask Sections in Combination. R. M. Cheney. *Foundry,* Vol. 64, Feb. 1936, page 84. Due to constant change in machine tools and other miscellaneous castings many changes are involved in length, width, depth and bar arrangement in flasks. Logical solution is to adopt definite standard sizes for flask sections which may be assembled in any desired combination. Describes method used by author. VSP (3)

■ 3a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Melts Scrap Metal in Brass Foundry. *Foundry,* Vol. 64, Mar. 1936, pages 26-27, 68. Where all scrap is used an intimate knowledge of miscellaneous material is required in making up charges. In ordinary jobbing brass foundry a great variety of castings may be made from all or nearly all scrap charges provided the foundryman is familiar with the material with which he is dealing. As a typical example describes procedure at the Keystone Brass Works, Erie, Pa. Includes a table giving the composition of typical brass and bronze mixtures. VSP (3a)

Comparison of Press Casting and Other Shaping Methods for Brass and Various Copper Alloys (Vergleich des Pressgusses und anderer Formgebungsverfahren für Messing und andere Kupferlegierungen) *Die Metallbörse,* Vol. 25, June 22, 1935, pages 786-787; June 29, 1935, pages 818-819. The author critically discusses why, in spite of its great perfection, press casting of brass and other Cu alloys will never completely displace forging, stamping, die, sand casting and other shaping methods. The most widely used press casting machines are described and the effect of various alloying elements on the press casting properties of Cu-rich alloys are considered. Brass containing 4-5% Si and 10-15% Zn is particularly suited for press casting purposes. A comparison between the brass press casting and Zn-base alloy die casting processes is made from the economic viewpoint. EF (3a)

Molds Numerous Types of Bronze Castings. *Foundry,* Vol. 63, Dec. 1935, pages 30-31, 66, 68. Describes casting procedure at the plant of Erie Bronze Co. Shop is equipped to handle castings from one oz. up to 2 tons. A 10 ton stock of solid and cored P bronze bushings is maintained. With slight variations most of bronzes are melted at temperatures of 2300° F. While in furnace metal is covered with a special flux. Additions of Ni, Mn and P are made in form of shot. Gives details of several mixtures and melting practice. Most of the castings are made in molding machines. VSP (3a)

Production of Powdered Alloys of Low Melting Point. R. W. Rees. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 193-195. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 436R/8. (3a)

Metal Losses in Melting Brass and Other Copper Alloys. Maurice Cook. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 53-57. Includes discussion. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 482R/7. (3a)

Observations of the Porosity and Segregation of Two Bronze Ingots. N. P. Allen & S. M. Puddephat. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 79-92. Includes discussion. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 438R/4. (3a)

Metal Melting—Its Effect on Quality. H. W. Brownsdon. *Journal Institute of Metals,* Vol. 57, No. 1935, pages 17-52. **Chemicals in Metal Refining.** *Chemical Trade Journal & Chemical Engineer,* Vol. 97, Sept. 20, 1935, page 242. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 2R/2. MS (3a)

Unsoundness in Aluminium Sand Castings. III. Solidification in Sand Moulds Under Pressure. D. Hanson & I. G. Slater. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 103-123. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 276R/6. (3a)

■ 3b. Ferrous ■

C. H. HERTY, SECTION EDITOR

Hydrogen as a Cause of Low Ductility in Steel (Wasserstoff als Ursache geringer Dehnung und Einschnürung von Stahl) C. Drescher & R. Schäfer. *Archiv für das Eisenhüttenwesen,* Vol. 9, Jan. 1936, pages 327-332. Basic open-hearth steel (C 0.16%; Si 0.9%; Mn 1.0%; P 0.042%; S 0.04%; Cu 0.38%) deoxidized with Al showed low elongation and reduction of area and a spotty tension test fracture. After heating at the low temperature of 500° C. or even 100° C. the ductility was raised and a uniform cup and cone fracture obtained. In experimental steels melted with inflow of H_2 flaky fractures of low ductility were obtained in the as cast, as forged, or normalized condition, but the flakiness and accompanying low ductility disappeared on heating at 100° C. In discussion there was rather general agreement that the low ductility was probably attributable to absorbed H_2. SE (3b)

Sand and Loam Molds (Die Schablonenformerei in Sand und Lehm) A. Geissel. Wilhelm Knapp Verlag, Halle (Saale), 1935. Paper, 6½ x 9½ inches, 137 pages. Price 7.50 RM.

This book, illustrated with 222 pictures (cuts) and 3 tables, is a guide for the practical foundry manager who would be interested in ferrous jobbing work of difficult nature requiring special mold preparations with brick work, sweeping arm, loom work and dry mold practice.

The addition of barn yard refuse and hair is recommended in core sand.

F. Valtier (3b) -B-

History and Purposes of the Open Hearth Committee, A.I.M.E. L. F. Reinartz. *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, pages 319-320. Committee was organized in 1925 for informal discussion of practical operating and metallurgical problems, many of which have been taken up at the conferences. Constitution of open-hearth slags and control FeO in slag and metal continue to hold interest of members. No outside research work has been attempted. MS (3b)

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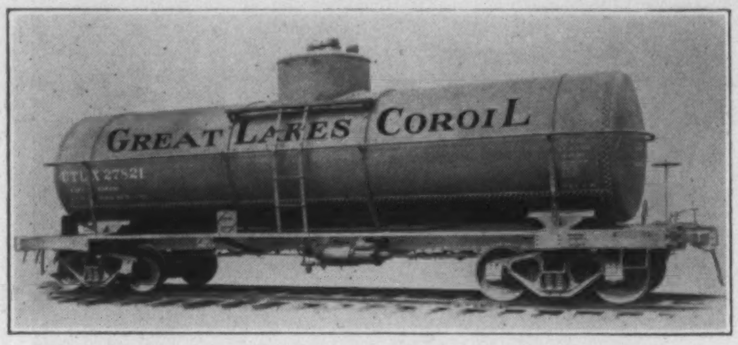

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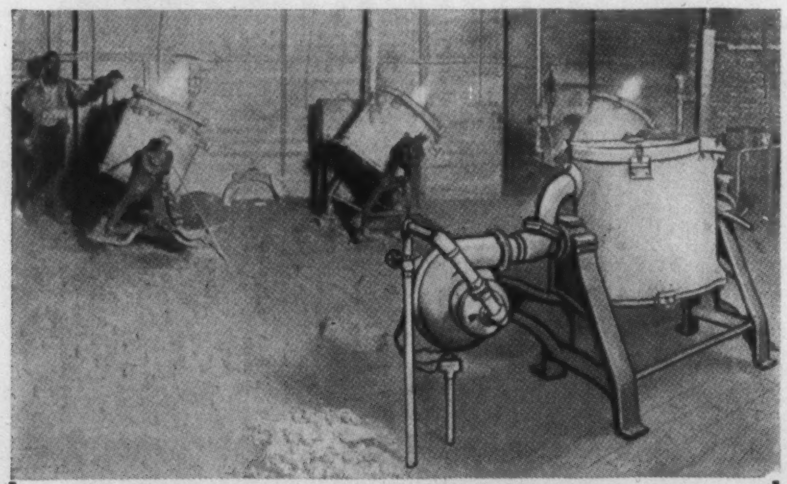

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Design and Application of Electric Steel Melting Furnaces, in Particular in Plants for High-Quality Steel (Ueber Bau und Anwendung der Elektrostahl-Schmelzöfen, insbesondere in Qualitätsstahlwerken). F. Pölzguter. *Elektrowärme,* Vol. 6, Jan. 1936, pages 38-46. Advantages of melting alloy steels electrically are discussed, furnace types described, and operating data given. Ha (3b) 1

2 **Recent Progress in Steel Making Reported from Germany. A correlated abstract.** S. Epstein. *Metals & Alloys,* Vol. 6, May 1935, pages 113-117; June 1935, pages 160-164; July 1935, pages 181-184; Aug. 1935, pages 219-222; Sept. 1935, pages 247-251. 53 references. Data are assembled on various aspects of steel making chemistry. Equilibria between slag and bath with effects of various oxides; temperature and production of fluid products of deoxidation; effects of C in bath on gas evolution; solubility of inclusions in liquid steel are discussed. Work on the effect of gases in steel (H, CO, N) is discussed. Slag requirements for desulphurization in basic open-hearth furnace are given. Two defects, "sand seams" and "flakes" have been extensively studied and this work is summarized. Statistical methods have been used in study of sand seams. The cause of flakes is more elusive depending upon melting, casting, forging, and heating and cooling rates. H absorption is said to be largely responsible for susceptibility to flake formation. Data are assembled resulting from work on slag control, use of Mn ore in open-hearth operation, jarring of ingots during solidification and direct rolling of molten steel. WLC (3b)

3 **Core Room Layout Features English Automobile Foundry.** Vincent Delport. *Foundry,* Vol. 63, Dec. 1935, pages 26-28, 71-72. Describes core room of the Austin Motor Co., Birmingham, England. The foundry is highly mechanized plant dealing with repitition work. Two types of sand are used. Sand is blown into core boxes. After cores are baked they are classified and placed on racks. Sand is constantly tested. VSP (3b)

The Use of Cement Sand in Steel Molding (Ein Beitrag zur Verwendung von Zementsand in der Stahlformerei) A. Gottwald. *Giesserei,* Vol. 22, Dec. 6, 1935, pages 603-604. A mixture of 100 parts (by weight) of sea sand, 13 parts of Portland cement and 10 parts of water is a very good cement sand for molding alloy and unalloyed steel castings, both acid and basic, for pieces 4 up to 1 ton, in particular for hard Mn steel. It is useful also for gray Fe for piston rings and cylinders. Ha (3b)

Steel Making in Relation to Weld Rod Manufacture. T. Swinden. *Symposium on the Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 2, pages 593-601. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 4R/6. (3b)

5 **Making Ferro Alloys (La production et la fabrication des ferroalliages)** P. H. Alfred Salmony. *Journal du Four Electrique,* Vol. 44, Dec. 1935, pages 433-434. Generalities. JDG (3b)

Metallurgy of the Induction Furnace and the Production of Tool Steel. S. L. Roberton. *Metal Treatment,* Vol. 1, Winter 1935, pages 179-185. A correlated abstract of recent publications from the Kaiser-Wilhelm-Institut für Eisenforschung, Düsseldorf. 13 references. JCC (3b)

6 **Evolution of Modern Methods for Purification of Steel (Evolution des procédés modernes d'épuration de l'acier)** Perrin. *Revue de Métallurgie,* Vol. 32, Oct. 1935, pages 466-468. Using deoxidation method proposed by the author (not described in the present paper) and open hearth metal made in any way and specified only by its C content and temperature, it is possible to control depth of quenching, to adjust the metal to give optimum properties after any desired heat treating cycle, to control the grain even in plain carbon steels and to adjust any desired factor one at a time. JDG (3b)

7 **Impurities and Purification of Steel (Impuretés et Purification de l'Acier)** Albert Portevin. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Aug.-Oct. 1935, pages 1914-1930. Lecture before the Société des Ingénieurs Soudeurs. Elements which are considered as impurities can be useful in some cases. Alloy elements can be harmful in some circumstances. For example: S is harmful for forgeability but is kept high to improve machinability. P is kept or added to prevent sticking during rolling. Cu which was considered as an impurity is now added to increase corrosion resistance. N is used in nitriding process. As also has been patented to improve machinability of stainless steels. C is an impurity in 18/8 Cr-Ni steels. Mn must be kept low in dynamo sheets and tool steel and for preventing atmospheric corrosion. Si must be low in sheets for deep drawing, etc. Amount of each element must also be taken in consideration. Little is scientifically known about Ca, O, Al, N, H owing to 8 difficulty of accurate determination of those elements. Furthermore effect of an impurity depends upon condition of this impurity in steel. Cr, S, Al and N for instance can be present as solid solution or in the combined state. Distribution of impurities is also of great importance. A special discussion is devoted to inclusions, interdendritic segregation and purification of steel. Chief purpose of purification is to eliminate S, P and O. 2 processes are used: (1) Precipitation. In the case of steel this method consists in adding C, Al, Ca, Na, Mg. Solid or liquid particles can be separated only partially and are present as inclusions in final product. (2) Extraction. In the case of steel, the slag absorbs the impurities. Author discusses static and kinetic chemical conditions of purification by slags and gives special attention to the new Perrin process. FR (3b)

9 **High Grade Cast Iron.** *Machinery,* London, Vol. 47, Nov. 21, 1935, pages 209-215. The production and working of Meehanite castings at the Rochester Works of Winget, Ltd. General discussion of foundry for producing cast Fe used in concrete-mixing and tile manufacturing machinery. WB (3b)

Gaseous and Solid Impurities in Ingots. J. H. Andrew. *Aluminium & the Non-Ferrous Review,* Vol. 1, Nov. 1935, page 59. Read before the Midland Metallurgical Society. A short general review. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 54L/8. JCC (3b) 10

Modern Foundry Production Methods. J. J. Sheehan. *Journal Institution of Production Engineers,* Vol. 14, Nov. 1935, pages 582-586. Further discussion of paper. For abstract of original paper see *Metals & Alloys,* Vol. 6, Apr. 1935, page MA 141L/9. JCC (3b)

Facts About Common Steels. J. R. Miller. *Blast Furnace & Steel Plant,* Vol. 24, Feb. 1936, page 171; Mar. 1936, page 243. Brief discussion of blast furnace, acid Bessemer and acid and basic open-hearth processes. MS (3b)

Modern Equipment for Chevrolet Foundry Increased Production 550%. *Mill & Factory,* Vol. 18, Mar. 1936, pages 42-48. Grey Iron Foundry at Saginaw, Mich., has in 16 years increased its output per employee from 200 lbs. to 670 lbs., and per square foot of floor space, 550%, with 50% cost reduction, by the introduction of modern machinery, conveyors, etc., by constant redesign of castings, and by adoption of short cuts wherever possible. Quality has improved, giving a more machinable cylinder block, and fewer leaky sections. Detailed description is included of plant equipment and layout, furnace charges, pattern-making, molding, pouring, conveying, etc. Maintenance costs and extent of personnel required are outlined. FPP (3b)

Cast Iron. *Marine News,* Vol. 22, Feb. 1936, pages 26, 33-36. Extract from second Andrew Laing lecture, N. E. Coast Institute of Engineers & Shipbuilders, Nov. 3, 1933, on recent metallurgical developments and their significance for shipbuilding and marine engineering. Various data from the paper and bibliography are put into tabular form and discussion is made of the effects of various alloying elements. WB (3b)

Present State of Die Casting (La fonderie sous pression: état actuel) Paul Bastien. *Revue de Métallurgie,* Vol. 33, Jan. 1936, pages 43-54. A brief description of methods employed in die castings, alloys used, principles of die design and defects in castings inherent in the practice. No new information. JDG (3b)

Recent Work on the Treatment of Cast Iron and Steels with Sodium Carbonate (Les Travaux Récents sur le Traitement des Fontes et des Aciers par le Carbonate de Soude) R. Berteaux. *Chimie et Industrie,* Vol. 33, May 1935, pages 631-638. Reviews the recent studies on the effect of sodium carbonate, which produces modifications in the structure, and reiterates the vital importance of desulphurization of the bath because of the effect on the quality of the product. MAB (3b)

Electro-Metallurgical Production of Iron-Silicon Alloys (Les Fabrications Electro-Métallurgiques des Ferro-Siliciums) Maurice Déribéré. *Science et Industrie, Electricité,* Vol. 20, Jan. 1936, pages 22-24. Gives a history of the subject and explains fundamentals of production. Furnaces with a single electrode and a current conducting hearth are the most used but other types of arc furnaces and resistance furnaces are sometimes resorted to. Problem is only to reach a high temperature. Author describes recent developments in arc furnace construction. Tension used varies from 25 to 80 volts per electrode. Capacity of furnaces is up to 25,000 kw. Current consumption varies according to Si content of alloys and capacity of furnaces. Typical numbers are as follows: for 25% Si, consumption is, in kw. hr./ton 3,200-4,000 for a furnace of capacity up to 4,000 kw. 3,000-3,500 for a furnace having a capacity over 4,000 kw. For 90% Si, corresponding consumptions are respectively 13,000-20,000 and 11,000-16,000. World production of Fe-Si alloys is about 200,000 tons. FR (3b)

The Production of Medium Sized Steel Castings. G. T. Hampton. *Iron & Coal Trades Review,* Vol. 132, Feb. 14, 1936, page 315. There are 2 fundamental differences between the production of Fe castings and steel castings; steel has a much lower proportion of metalloids and therefore a higher m.p. and decreased fluidity range, and in cooling there is greater contraction from the liquid state and volume changes are undergone when passing through the critical range. A closer coöperation between designer, pattern maker, molder and metallurgist together with departmental supervision is therefore necessary for successful operation of a steel foundry. Shrinkage and dimensions, application of chills and correct estimation of factors involved are discussed. Ha (3b)

Finishing the Heat of Steel. Pts. XL and XLI. J. H. Hruska. *Blast Furnace & Steel Plant,* Vol. 24, Feb. 1936, pages 160-161; Mar. 1936, pages 239-240, 257. Discusses supporting lugs or hooks for ingot-molds; molds accelerating solidification of steel; and design of mold stools. Any type of lifting lug should be constructed with sufficiently rounded corners. Wrought-Fe hooks are to be preferred to those of soft iron or Bessemer or open-hearth steel because of better impact resistance. Air or H_2O cooling of molds has not yet found commercial acceptance. Cu molds are used in only a very few plants. Mold stools should be designed with thorough consideration for mechanical and thermal requirements, but otherwise with greatest simplicity. Heavy stools are less likely to crack prematurely. Part XLI. Discusses grading of ingot-steels and making of forging ingots. Ranked according to origin, electric and crucible steels are first, open-hearth grades next, and Bessemer steel last. Whether acid or basic grades are to be preferred has not been settled definitely. In addition to low P and S, other factors, such as presence of O_2, should be considered in judging quality of steels. Forging ingots are generally produced from well finished killed steel. Quality forgings require proper deoxidation of melt, use of polygonal or round cross-sections of ingots and molds, and very careful pouring practices. Cold pouring is advisable in most cases. MS (3b)

Cast Iron and the Electric Furnace (La fonte et le four électrique) Auguste Le Thomas. *Revue de Métallurgie,* Vol. 33, Jan. 1936, pages 14-23. Electric furnace can be used either for making pig iron for remelting or for melting iron in the foundries. Greatly improved properties can be given by this method as compared with a blast furnace iron melted in a cupola. JDG (3b)

Foundry Pig Iron Made in Smaller Size. G. A. T. Long & W. M. Ramsey. *Steel,* Vol. 98, Mar. 16, 1936, pages 55-56. "Meltrite" pig-Fe introduced by Picklands-Mather & Co., while of the same length, is of much smaller cross-sectional area than customary pigs. New-type pigs weigh about 40 lbs. each. Their use in cupola or air furnace results in more uniform and faster melting, and lower oxidation losses and fuel consumption. If heavy pig-Fe or heavy scrap is used in addition to new type of pig, heavy sections should be charged first. MS (3b)

Notes on Some Common Defects in Steel Castings. C. Howell Kain. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 501-525. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 363. CEJ (3b)

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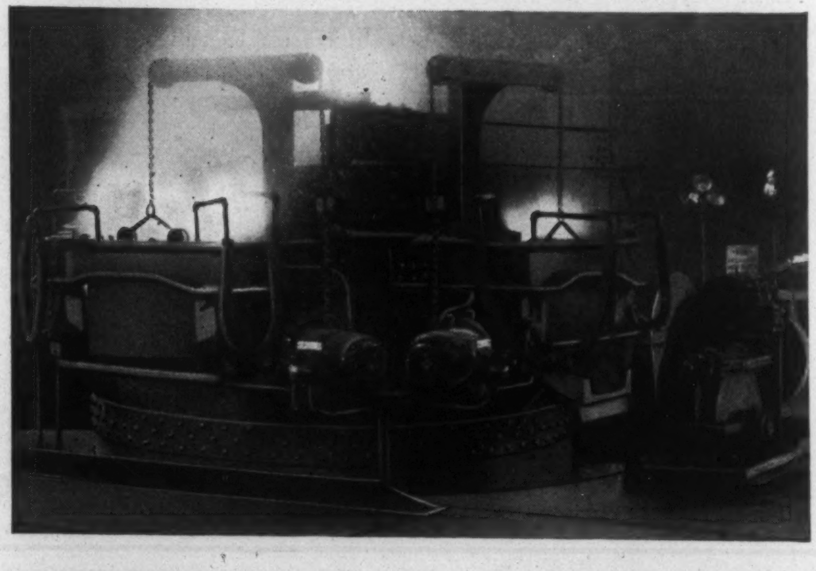

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Desulphurization of Pig Iron and the General Laws Governing the Desulphurization of Iron. Hanns Wentrup. *Iron & Steel Institute, Carnegie Scholarship Memoirs,* Vol. 24, 1935, pages 103-166; *Technische Mitteilungen Krupp,* Vol. 4, Mar. 1936, pages 38-58. The laws governing the desulphurization of Fe are discussed and many data including that of the author and many previous investigators are presented to show that desulphurization can now be described to a greater extent in quantitative terms than previously. Desulphurization depends on temperature and also on (1) the solution of S in the slag, (2) a reduction in the power of Fe to dissolve S, (3) the conversion of Fe sulphide into sulphides which are insoluble in Fe, (4) a combination of (1) and (3), and (5) a combination of (2) and (3). The ratios of S in the slag to S in the Fe under various conditions are calculated by use of the partition law. The author shows that a reduction in the power of Fe to dissolve S is brought about by such elements as C, Si, and P which force S out of the Fe. Mn causes desulphurization by converting Fe sulphide into an insoluble Mn sulphide. In slag desulphurization the reaction is usually between Fe sulphide and the oxide of Mn. Parts of important systems presented and discussed in this investigation include the following: Fe-S, Fe-S-O, Fe-S-C, Fe-S-P, Fe-S-Mn, Fe-S-Mn-O, Fe-S-Ca-O, Fe-S-Mn-C, Fe-S-Mn-C-Si, Fe-S-Mn-C-P, and Fe-S-Mn-C-P (-Si). Numerous equilibrium constants are calculated and interpreted to show the course of the desulphurization of pig Fe. The authors conclude that to insure a satisfactory desulphurization, C, Si, P, and Mn should be present in the Fe and the Fe should be cooled. C, Si, and P reduce the saturation content of S at temperatures of 1250-1350° C. strongly enough to start the desulphurization required in practice. Desulphurization of pig Fe in the ladle and mixer is simply a process of the segregation of the Fe and Mn sulphides. 46 references. Ha + CW (3b)

Study on Formation of Iron Nitrides Through Melting and on Iron-Nitrogen System (Etude de la Formation des Nitrures de Fer par Fusion et du Système Fer-Azote) D. Seferian. *La Technique Moderne,* Vol. 28, Jan. 1, 1936, pages 10-12. In steel, N imparts hardness but also brittleness according to content. Author summarizes study of Fry and explains briefly nitriding process. Direct action of N on molten steels has been but little studied. Very little N is dissolved but steel becomes brittle. Quantity of N absorbed depends upon melting process: For open hearth steel, N content is about 0.010%, for converter steel N content can reach 0.020%. During torch melting (welding) N absorption can also reach 0.020% and when welding is carelessly performed can give a N content up to 0.20%. Author deals more particularly with latter point. FR (3b)

Some Experiences with the Balanced Blast Cupola. H. H. Shepherd. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 348-372. See *Metals & Alloys,* Vol. 5, Oct. 1933, page MA 332. CEJ (3b)

Contribution to the Supply of Blast in the Cupola Furnace (Beitrag zur Windversorgung des Kupolofens) Hans Schmidt. *Giesserei,* Vol. 23, Feb. 28, 1936, pages 107-111. An investigation on a cupola has shown that the usual methods of determining the blast are not quite correct. A certain excess of air must be considered which burns the CO in the upper part of the shaft and thus escapes the gas analysis. Ha (3b)

Coke Consumption 6% and Charge 100% Scrap! (Koksverbrauch 6% und Schmelzeinsatz 100% Bruch!) Carl Rein. *Giesserei,* Vol. 23, Feb. 14, 1936, pages 78-81. The fallacy of low coke consumption by wrong reference of coke to charge is explained; no exclusive scrap charge can be used continually, first because of poor quality of the Fe produced and second, for economic reasons, as soon not enough scrap would be available. Ha (3b)

Bibliography of Literature on the Effect of Aluminum in Cast Iron. Bureau Report No. 145. G. R. Woodward with notes by J. W. Bampflyde. *Bulletin British Cast Iron Research Association,* Vol. 4, Jan. 1936, pages 264-271. 51 chronologically listed references given which do not include textbooks or patents. WB (3b)

Relation Between the Design of the Burners, Output, and Refining of Basic Open-Hearth Furnaces (Zusammenhänge zwischen der Kopfbauart, Leistung und Frischwirkung von Siemens-Martin-Oefen) F. Wesemann. *Stahl und Eisen,* Vol. 55, Sept. 12, 1935, pages 981-989; Sept. 19, 1935, pages 1006-1009. A large amount of data are given to show that the design of the burners affects not only the furnace output but also the manner of refining through the rate of C drop and degree of oxidation of the bath. Reducing the excess air lowered the output. SE (3b)

New Vacuum Furnace and Its Use for Oxygen Determination in Steel (Ein neuer Vakuumofen und seine Anwendung zur Sauerstoffbestimmung im Stahl) G. Thanheiser & E. Brauns. *Archiv für das Eisenhüttenwesen,* Vol. 9, Mar. 1936, pages 435-439; *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 17, No. 18, 1935, pages 207-211. A new vacuum fusion apparatus for the determination of O_2 in steel is described. The blank being very small the furnace may prove suitable for also analyzing other gases in steel. The interfering effect of Mn on O_2 content was studied and found to depend on the cooling conditions above the crucible. Ha + SE (3b)

The Rotary Furnace in Foundry Practice. R. Boutigny. *Metal Industry,* London, Vol. 47, Nov. 1, 1935, pages 445-448. Paper presented at the International Foundry Congress, Brussels. See "The Utilization of Electric Arc Furnace," *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 56R/9. HBG (3b)

Develops Aluminum Flask for Producing Test Bar Molds. Edward Grant. *Foundry,* Vol. 64, Jan. 1936, pages 33-34. Describes flasks developed to facilitate production of cast Fe tensile and transverse test bars. Flasks are made up of 2 cast Al plate sides, 6 steel cross members and 2 steel end plates. Side plates are ⅜" x 4" x 18" and 6 steel strips are 3/6" x 1" held by screws in recesses in edges of plates. VSP (3b)

Changed Design of Corebox to Speed Production of Tank Cores. G. O. Ekstedt. *Foundry,* Vol. 64, Jan. 1936, page 34. Casting loss due to wet paste joints, improperly gaged cores or weak stop-off are eliminated by new design of corebox for tank heaters. The equipment designed by author produces a one piece core, thus eliminating the rubbing of old type of half cores to a bearing, and gaging complete core for size. Green core is made in 2 half boxes, but they are joined to form a complete core before core is placed in oven. VSP (3b)

4. WORKING

Some Non-Ferrous Metal Powders. J. C. Chaston. *Aluminium & Non-Ferrous Review,* Vol. 1, Mar. 1936, pages 229-231. The manufacture, characteristics, and uses of Mg, Al, Cu, and Pb powders are briefly reviewed, with special reference to the importance of correct particle shape. Mg powder for pyrotechnics is made by machining thin shavings from the solid, Al powder by the stamp mill or, more recently, the Hametag ball mill processes, Cu powder by electrolysis, and Pb powder for paints by atomizing molten metal. JCC (4)

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

The Broken Hill Proprietary Company Limited (Iron and Steel Works) Combination Merchant and Skelp Mill and 12 In. Mill. W. J. Todhunter & C. B. Kirkhouse. *Proceedings Australasian Institute of Mining & Metallurgy,* No. 99, Sept. 30, 1935, pages 357-374. A detailed plant description. AHE (4a)

Progress in the Knowledge and Practice of Methods of Plastic Deformation. III. Skew Rolling and Piercing (Fortschritte in der Erkenntnis und Handhabung der Verfahren zur bildsamen Formgebung. III. Schrägwalzen und Pilgern) E. Siebel. *Metallwirtschaft,* Vol. 15, Mar. 20, 1936, pages 277-279. Points out that practically all improvement has been in the direction of skew rolling equipment rather than toward a sound theoretical understanding of the process. Different types of successful mills are described. GD (4a)

Copper-lead Antifriction Alloys (Les Alliages antifrictions Cuivre-Plomb) A. Ricard. *Cuivre et Laiton,* Vol. 9, Mar. 30, 1936, pages 127-130. The advantage of Cu to alloy with Pb in any proportion for bearing metals is explained and the characteristics of such alloys discussed; 0.5 to 20% Pb are added and give well defined properties which are demonstrated in the ternary diagram Cu-Sn-Pb. Four zones are distinguished: (1) inferior mechanical qualities but high plasticity, (2) improved mechanical properties with greater Sn content, perfect plasticity, (3) considerable mechanical strength, with a plasticity that is sufficient under high loads, (4) optimum of mechanical properties, no plasticity and easily worn by abrasion. The fields of employment of the 4 groups for industrial purposes are given and results from French railways cited. Ha (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Power Consumption in Forging and Pressing Aluminum Alloys. A. v. Zeerleder & R. Irmann. *Metal Industry,* London, Vol. 47, Oct. 4, 1935, pages 350-353. **Power Consumption in Forging Light Alloys.** *Metal Treatment,* Vol. 1, Autumn 1935, pages 152, 161. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 182L/9. HBG + JCC (4b)

Extrusion of Nickel and Its Alloys. W. R. Barclay. *Metal Industry,* London, Vol. 47, Nov. 15, 1935, pages 494-496. Author reviews possibilities of extrusion of Ni alloys. One advantage of this process is that alloys difficult to forge may, when extruded, be cold-worked with greater ease. Until recently extrusion of Ni and its alloys has received little consideration, due to the fact that they are in the "high temperature" range. The properties of Ni which make extrusion difficult, mechanical strength at high temperatures and resistance to deformation, together with toughness and resistance to heat and corrosion are the properties that make extruded alloys valuable to industry. Examples are cited of Ni-containing alloys that are being extruded in tubes and in sections. Close collaboration between engineer and metallurgist is essential. The development of the presses necessary for this work is discussed and problems of both the engineer and the metallurgist are cited. In addition to the factors mentioned, the fundamental requirement for successful extrusion is the casting and preparation of the billets to be extruded; unless the metal is clean, free from slag, blowholes, and surface defects, and uniformly heated throughout, satisfactory extruded material cannot be obtained. HBG (4b)

Pressing of Nickel and Its Alloys (Das Pressen von Nickel und seinen Legierungen) W. R. Barclay. *Metallwirtschaft,* Vol. 15, Mar. 13, 1936, pages 253-255. The many fine properties of Ni alloys will force the development of a pressing technique comparable to that now existing for Cu and Al alloys. Better mechanical equipment can be produced and attention must also be directed to proper working speeds and temperatures and the use of high quality alloys. GD (4b)

Forging and Heat Treating Locomotive Parts. J. B. Nealey. *Iron Age,* Vol. 137, Mar. 19, 1936, pages 38-42. Discusses in detail the forging and heat treating operations as well as the equipment used in the Pennsylvania Railroad shops at Altoona, Pa. Several economies were effected when furnaces were changed from producer gas or oil to manufactured gas. VSP (4b)

Cold Extruding of Aluminum Shells (Kaltspritzen von Aluminium-Hülsen) O. Kühner. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Feb. 1, 1936, page 132. The manufacture of Al tubes and shells by extruding is described. The smallest wall thickness obtainable was 0.1 mm., the greatest more than 1 mm. at 8-80 mm. diam. Ha (4b)

Kropp Forge Company. W. C. Kernahan. *Heat Treating & Forging,* Vol. 22, Apr. 1936, pages 167-170. Outlines history of company, and describes forging, heat treating, machine-shop, and miscellaneous equipment in plant at Chicago. MS (4b)

■ 4c. Cold Working, including Shearing, Punching, Drawing & Stamping ■

Developments in Steel Wire Manufacture. KENNETH B. LEWIS. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 51-54. Synthetic carbide dies have found general acceptance. They have contributed largely to progress in developing special finishes through their accurate shape, high polish, and ability to do their work with an extremely thin film. Conditions in the pickling and cleaning house have been greatly improved by use of inhibitors—probably greatest single factor—use of automatic temperature control, ventilation, and periodic testing of acid and lime baths. Recently introduced baking-ovens are in the form of long narrow compartments, constructed of insulated steel panel sections, through which preheated air is circulated at automatically controlled speeds and temperatures. Importance of inherent grain size is receiving increased attention. There is a growing interest in stress distribution in wire during its passage through the die. It is possible that large reductions in friction loss and power requirements can be effected by giving wire a preliminary stressing by a backward pull on free end, thus reducing pressure between die and wire. MS (4c)

Some Recent Developments in Tungsten Die Practice. JAMES R. LONGWELL. *Wire & Wire Products,* Vol. 11, Feb. 1936, pages 72-75, 100. The advantages of W carbide, its recent improvements and the economies to be obtained by the use and proper care of carbide dies in the production of sheet metal parts, in the bolt and nut industry, and in using cemented carbide for upsetting punches and header dies are discussed. Ha (4c)

Manufacture of Steel Tubes. Mechanical Operations and Their Effects. J. W. JENKIN. *Iron & Coal Trades Review,* Vol. 132, Jan. 10, 1936, page 45. The steel used in England for the manufacture of steel tubes is usually a mild steel of the killed type composed of 0.10-0.15% C, 0.3-0.8% Mn, up to 0.3% Si, and S and P each below 0.04%, generally below 0.03%. Inclusions which are ductile are not injurious to the tubes, as e.g. Mn sulphide, but non-ductile inclusions, such as alumina and silicates, can give considerable trouble both in hot and cold working as they interfere considerably with the flow of material in mechanical operations. Oxide inclusions, although rarer, are equally harmful. The Mannesmann, Stiefel and Pilger mills are described. The properties of tubes are affected by manufacturing methods of the products for which the tube is used, brazing being very often a process which makes the tube extremely brittle by the non-ferrous metal penetrating the steel along the grain boundaries. Intergranular failure can occur by oxidation at high temperatures, e.g. in superheater tubes; caustic embrittlement of boiler plates also is an intergranular failure. Under alternating stress at high temperatures, with oxidation, failure is hastened just as corrosion accelerates fatigue failure at ordinary temperature, due to trans-crystalline and inter-crystalline high temperature corrosion fatigue. Ha (4c)

Cold Deformation of Metallic Materials and Its Influence on Quality with Particular Consideration of Cold Working of Aluminum (Die Kaltverformung metallischer Werkstoffe und ihr Einfluss auf die Gutwerte unter besonderer Berücksichtigung der Aluminium-Kaltverformung) LEONHARD WEISS. *Aluminium,* Vol. 18, Mar. 1936, pages 96-97. Cold deformation is applied to a metal to improve its surface and also its properties. As Al has a strong tendency to combine with steel, cold working of pure Al is used only to a limited extent. Tensile strength and hardness are increased, electric conductivity is reduced. The increase of strength in a metal by cold processes depends on the conditions of working (reduction), and the latter depend on, and are limited by, the shape and dimensions of the material. The properties are the more improved the less energy the cold deforming process requires, that is, the easier the material follows the deforming forces. Ha (4c)

■ 4d. Machining ■

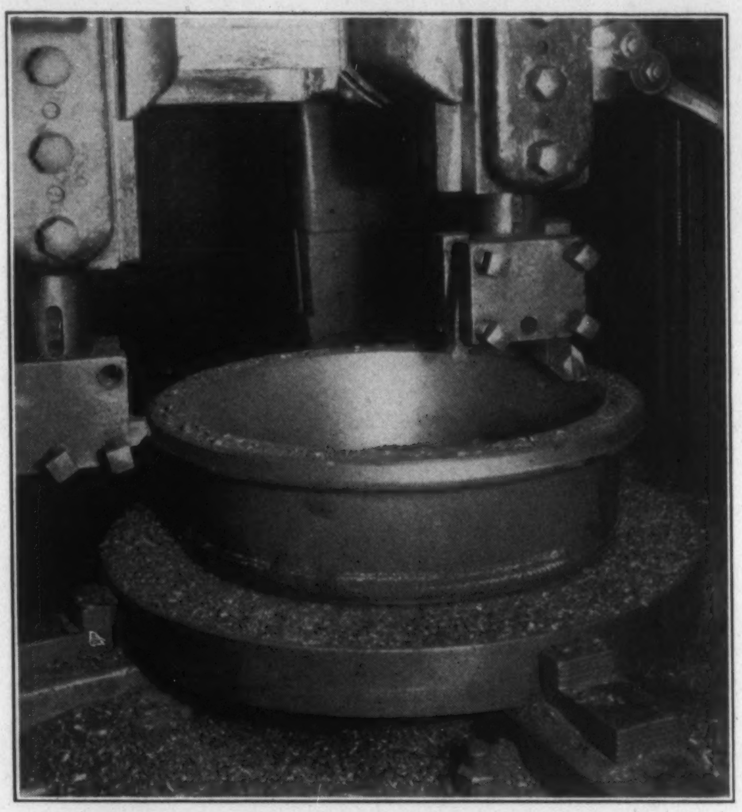
H. W. GRAHAM, SECTION EDITOR

Steadiness of Chip Pressure Makes Economical Reaming. EDWIN L. CADY. *Mill & Factory,* Vol. 18, May 1936, pages 61-63. Reaming theorists are divided into 2 schools advocating (1) abundance of reaming stock, slower speeds, lighter feeds and rigid alignment, or (2) less stock, high speeds, heavy feeds and floating reamers. Successful reaming is discussed with reference to miniminzing bell mouth and chatter, and to improving accuracy, service life and operating economies. In spite of theories the reaming chip pressures are the most important factors; control of chip pressure is easier when its effect on the reamer may be ignored and only its effect on speed and accuracy need be considered. Chip pressures are influenced by material to be worked, kind of hole, and companion operations, as fixed factors. Adaptable factors are speeds, feed, stock, lubricants, etc. FPP (4d)

Recent Developments in Small Tools. FRANK W. CURTIS. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 277-280, 282-284, 286, 288, 290; Jan. 9, 1936, pages 10-16. Recent developments in small tools have contributed greatly to art of metal cutting. Solid high-speed steel tools for milling cutters, drills, reamers and hobs are available in 3 types of steel. Most common is the standard 18% W, 4% Co and 1% V. More recently the addition of V up to 2% performs better on certain types of cuts. Another type of steel is a super high-speed, containing 18.5% W, 4.5% Cr, 1.75% V, 1.00% Mo and 9% Co. This steel is better for heavy duty cutting. Improvements in high-speed steel have been directed more toward refinement of structure and physical properties to insure uniformity. Combination tools are becoming more universal. Turning tools are also receiving gradual improvements. Discusses Firthite tipped tools. Other tools considered are carbide tools, radius cutters, broaching tools and sintered tungsten carbide tools. VSP (4d)

Plymouth Flywheel Machined at Rate of 44 an Hour in Two Operations. *Iron Age,* Vol. 137, Apr. 9, 1936, pages 44-45. Flywheels are machined in 2 operations by a battery of 2 radial slide simplimatic lathes. Results are attributed to a new design which permits maximum number of cutting tools to cut simultaneously at high speed. Tungsten-carbide and stellite J-metal tools are used in roughing operations. Bed and headstock are cast from Ni semi-steel. VSP (4d)

A Tough Job Made Easy
with
FIRTHITE



"Firthite Tools machining cast iron brake drums.
Brinell Hardness 196 to 207.
Depth of cut 3/16" to 5/16".
Speed 140 feet per minute.
Time between grinds 15.2 hours.
Number of pieces between grinds 40.
Two grades of High Speed Steel were tried on this job before Firthite was used. One grade gave one piece per grind at 80 feet per minute, and the other grade failed completely at that speed."

Out-of-date cutting materials jeopardize economies and the increased output expected from modern machine tools while Firthite assures both.

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5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

5a. Annealing

Practical Annealing of Steel Castings. J. R. MILLER. *Heat Treating & Forging,* Vol. 22, Apr. 1936, pages 188-190. Annealing of steel castings improves strength, due to grain refinement, decreases resistance to wear, and tends to make a large casting or group of castings more uniform in quality. Amount of improvement that can be attained depends upon condition of casting when it comes out of the sand, particularly with reference to grain size and composition, segregation, etc. Heat treatment of coupons should be carried out while coupon accompanies casting itself and not in the laboratory. As low-C castings require higher temperatures than high-C castings, furnace load should consist of castings of similar composition. Heating up must be done very slowly. No part of casting should be at too high a temperature and soaking time should not be prolonged beyond that which is necessary. Charge must be carefully cooled in furnace to a cherry red and then may be air cooled. Presents results of tests on a large number of acid open-hearth steel castings with varying C content, about 0.04% P, 0.60-0.80% Mn, and 0.30-0.35% Si. These indicate that annealing improves ductility in all C ranges, increases ultimate strength where C is more than 0.30%, and increases yield-point where C is more than 0.35%. However, the last property is decreased in the case of the lower C ranges. Machinability of all castings is improved.
MS (5a)

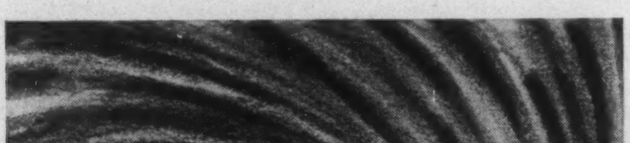
Notched-Bar Bend Tests of Longitudinal and Transverse Specimens—Influence of Annealing and Overstrain. J. MUIR. *Journal Royal Technical College,* Vol. 3, Jan. 1936, pages 531-541. The results of notched-bar bend tests on specimens similarly cut from the same bar, 1½" diameter, of 0.30% C steel, when the steel was in the normalized condition as supplied, when it was overstrained by tension, and after annealing at 920 and 1000° C., are given. It was found that longitudinal specimens snapped at the V-notches, the fibers being broken across, while with the transverse specimens the fibers were simply torn asunder, the specimen opening out at the V-notches without snapping. The fibrous nature of the material, whether normalized or annealed, is shown by photographs of the fractured sections of the notched-bar which have been cut transversely from the original bar.
JWD (5a)

5c. Aging

Age-Hardening of Brass. KANZI TAMARU. *Kinzoku no Kenkyu,* Vol. 13, Apr. 1936, pages 150-155. In Japanese. "Inkubationszeit" in aging 4 : 6 brass was re-examined by hardness test, electric resistance measurement and differential thermal analysis. Specimens, 59.11% Cu, having diameters of 4.2 mm. and 1 mm. respectively, were quenched from 870° C. and aged at different temperatures in high vacuum. The results of investigation are as follows: (1) The "Inkubationszeit" was not found in both electric and hardness measurements. (2) The electric resistance in quenched state is larger than in the annealed state. This fact is in contrary to Hansen's conclusion. (3) The electric resistance in quenched state was nearly the same as the sum of 3 electric resistances, that is, that of annealed state, that due to the quenching stress and that due to the transformation. (4) In aging, a faint heat absorption was found near 130° and 460°; a small heat evolution at 260° and a larger one at 310°, respectively. The first heat absorption seems due to the atomic rearrangement and the one at higher temperature to the transformation from β' to β. The small heat evolution is due to the separation of α phase from β and the larger one to the transformation from β to β'.
KT (5c)

The Mechanism of Age-Hardening—A Review of Recent Researches. *Metal Industry,* London, Vol. 47, Nov. 1, 1935, pages 435-439; Nov. 8, 1935, pages 464-468. Primarily this article deals with the basic mechanism of age-hardening. Certain examples of age-hardening alloys such as Al-containing Monel metal, Cu, alloyed with 2.5% Be and their physical properties are discussed. In its broader application, age-hardening is now defined as embracing changes, not always beneficial, as a result of exposure in or passage through a suitable range of temperatures. In present article the term is used, in a more restricted sense, to changes in hardness and auxiliary phenomena accompanying these changes, of alloys showing these effects without subjection to cold work. The author endeavors; (1) to summary of observations contained in recent papers which tend to indicate the mechanism of age-hardening; (2) to consideration of the constitution of age-hardening alloys, based on data from various types of testing; and (3) to a discussion of some theories and speculations that have been advanced. 121 references.
HBG (5c)

Research on Aging Phenomena (Entwicklung und Ergebnisse der Forschungen über Aushärtungsvorgänge) G. WASSERMANN. *Archiv für das Eisenhüttenwesen,* Vol. 9, Nov. 1935, pages 241-245. A general discussion of aging in Al alloys. It is considered that age-hardening is not necessarily accompanied by actual precipitation, but by a not clearly understood preparatory stage. Fe alloys seem to behave very similarly to Al alloys in this respect.
SE (5c)



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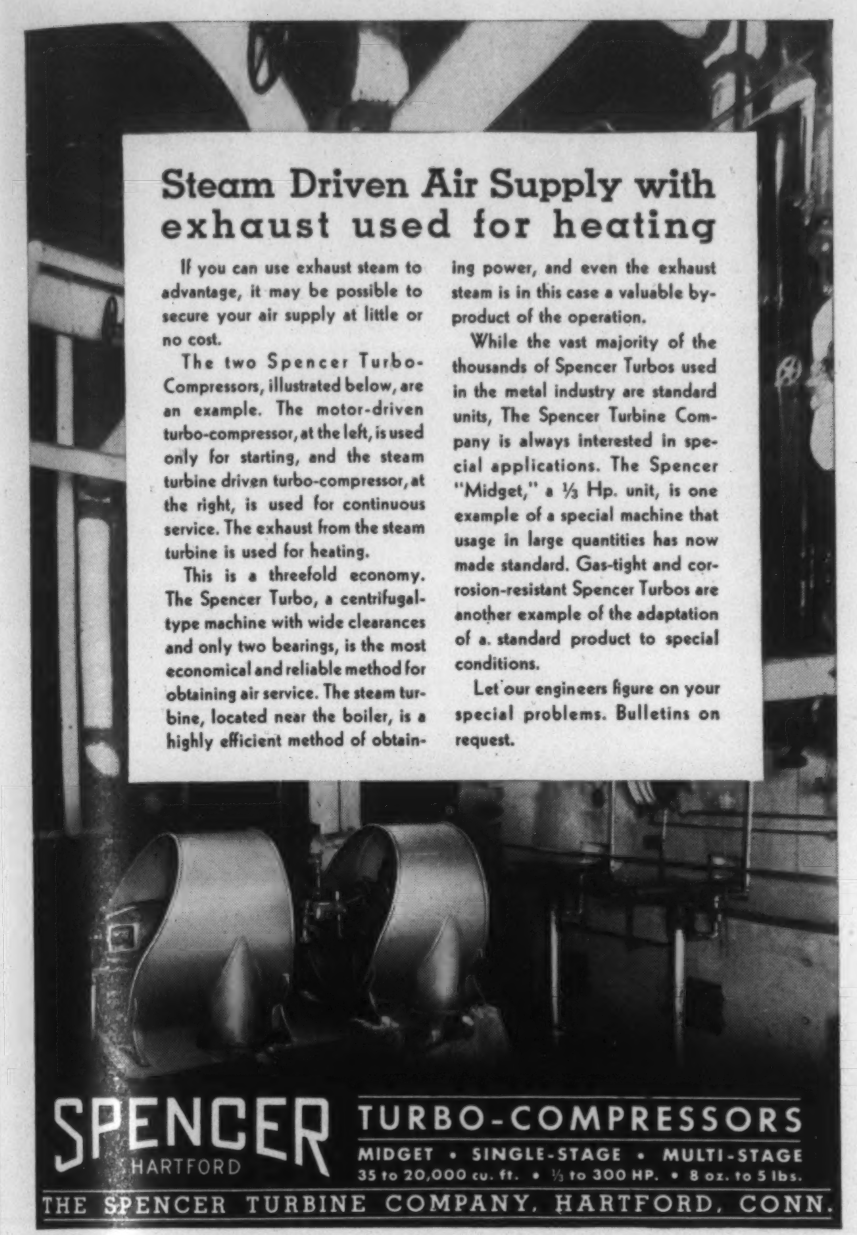

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S-69

5e. Carburizing

Decarburization of Several Alloy Steels by Hydrogen (Entkohlung einiger legierter Stähle durch Wasserstoff) W. Baukloh & H. Guthmann. *Archiv für das Eisenhüttenwesen,* Vol. 9, Oct. 1935, pages 201-202; (abstract) *Foundry Trade Journal,* Vol. 53, Dec. 19, 1935, page 457. The decarburization in H_2 at 700° to 1000° C. of several C steels and Ni, Cr, Mn, Si, W, Mo, V, Sn, and Cu steels, was determined. In C steels above 700° C. the rate of decarburization increased with increasing C content; below 700° C. it decreased. Steels containing 0.9% Cr showed the most resistance to the effect of H_2.

AIK + SE (5e)

5f. Nitriding

Present State of Nitriding Technique for Steel and Cast Iron (L'état actuel de la téchnique de la nitruration de l'acier et de la fonte) Federico Giolitti. *Revue de Métallurgie,* Vol. 33, Mar. 1936, pages 145-156. Critical summary of published data. For 90% of all used, 2 types of steel are sufficient: 0.20-0.55% C, 0.15-0.35 Si, 0.40-0.55 Mn, 1.40-1.80 Cr, 0.15-0.30 Mo, 1.0-1.20 Al and 0.25-0.55 C, 0.20-0.35 Si, 0.40-0.60 Mn, 1.70-2.00 Cr, 0.20-0.35 Mo, 0.30-0.40 Al. For each group, C content might be subdivided into 0.20, 0.40 and 0.50 range. Ni should be kept under 0.20%. Wide permissible variations both in composition and heat treating permit obtaining with these steels 45-160 kg./mm.^{2} tensile strength, 35-145 kg./mm.^{2} elastic limit, 28-6% elongation, 28-5% reduction of area. Steels of the first group have 1200 Vickers hardness, those of the second 900 to 1000. Hardness and wear resistance of nitrided steels of the second group is better than that of carburized and heat treated steels leading to rapid replacement of the latter. This is further promoted by the lack of deformation and strains in nitrided articles. An intermediate alloy between the 2 previous groups containing 0.6 Al and about the same content of other elements. Its properties lie between the two. When impact resistance is required Al is cut down to 0.10-0.15, but Cr raised to about 2.6%, Mo to 0.45 and about 0.20 V is added. One group of alloys is composed so that the core hardens on heating during nitriding. Austenitic steels are used only for valves of internal combustion motors, and only the valve stems are nitrided. Nitriding practice is described. Some industrial applications are given. Only centrifugally cast Fe can be nitrided easily, because the other methods of forming it still result in much trouble during nitriding. Nitrided cast Fe pipes are used commercially to advantage. Composition is not standardized as yet, but a representative one is: 2.7% C, 2.5 Si, 0.7 Mn, 2.0 Cr, 0.3 Mo and 0.8 Al.

JDG (5f)

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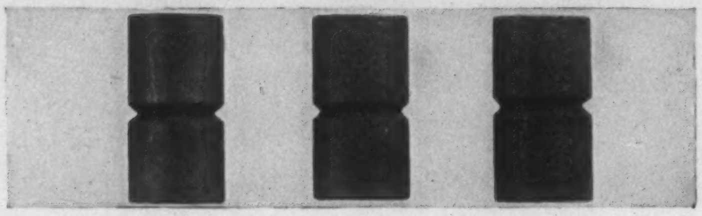
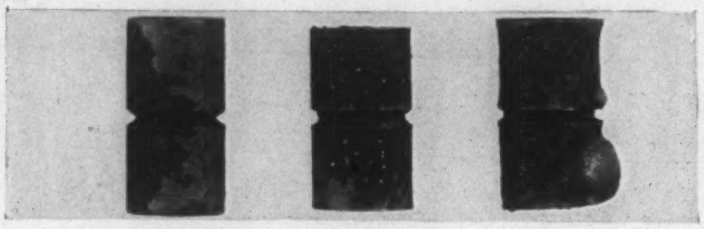


A
CERTAIN CURTAIN
Pre-Combustion Control

Above are three of six identical pieces of high speed steel, one held normal, one twice normal and one three times normal in "Certain Curtain" Pre-combustion Control furnace atmosphere. Note there is no attack on the surface.



B
OTHER FURNACE
Burning Gas Control

Here are three more of the pieces, one held normal, one twice normal, and one three times normal in another furnace whose "atmosphere control" readings were exactly the same as in the "Certain Curtain" Furnace above. Note destruction of the surface on the two held over time.

YOU want your hardener to do a lot more than merely avoid spoilage—you expect him to bring out the MAXIMUM WORKING QUALITIES of the steels he heat treats. He can do this with a "Certain Curtain" furnace because he can give the tools plenty of time at the critical without fear of surface attack.

The Hayes patent is the only one which provides PRE-COMBUSTION of the furnace atmosphere gases, thus assuring a stable, uniform, consistent furnace atmosphere which produces the difference in results noted above. Other furnaces may give you the same manometer readings and

Other furnaces: Point-of-Perfection — Margin-of-Safety — Tool held proper length of time at desired temperature — TOOL SPOILED

CERTAIN CURTAIN FURNACE: Point-of-Perfection — MARGIN — OF — SAFETY — Tool held proper length of time at desired temperature — Tool may be held many minutes past Point of Maximum Hardness without injuring the steel

even the same analysis of furnace atmosphere samples, but they do not give you the same effect on the steel—which is all you care about.

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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Considerations in Developing a Mineral Wool Industry. CHARLES F. FRYLING & ORVAL WHITE. *Chemical & Metallurgical Engineering,* Vol. 42, Oct. 1935, pages 550-553. From a paper given before the Third Annual Mineral Industries Conference of Illinois, Urbana, May 18, 1935. Manufacture and future developments in manufacture of mineral wool are discussed. The important use is heat insulating material. Present day cupola practice is described. Corrosion of refractories caused trouble in initial brick furnace. PRK (6)

Foreign Raw Materials in German Electric Furnaces (Fremde Rohstoffe im deutschen Elektroofenbau) W. FISCHER. *Elektrowärme,* Vol. 6, Jan. 1936, pages 13-17. Metals and refractories which have to be imported into Germany for the construction of electric furnaces are discussed. About 50 tons of Ni are used yearly; Cr and asbestos are some of the imported materials. Replacement by domestic materials is investigated. Ha (6)

Steel Ladle Refractories. A. JACKSON. *Metallurgia,* Vol. 13, Jan. 1936, pages 93-94. Discusses materials and design of refractories, including lining, sleeves and stopper head. JLG (6)

Recent Developments in Refractories. C. E. MOORE. *Iron & Coal Trades Review,* Vol. 132, Jan. 3, 1936, page 4. Improvement of existing and creation of new refractory materials in recent years are discussed. Accuracy of size and shape have been considerably improved without increase of cost. The alumina content in firebricks is now higher than formerly, and sillimanites are used extensively. Smaller sizes have been found advantageous and more economical. Carborundum and siloxicon are widely used in muffles, furnace tubes, refractory supports. Clay-bonded carborundum is now generally reserved for uses such as kiln tiles, furnace bottoms and crucibles where neither the greatest refractoriness nor the highest thermal conductivity are required. Severe conditions are met with by crystallized carborundum which possesses both high thermal conductivity and great strength. Zr silicates have found application where the high price permits, as in laboratory and special furnace work; although this material is non-spalling and has high refractoriness and strength, its slag resistance, especially to metallic oxides, is poor. Ha (6)

Use of Pulverized Fuel in Copper Refining. A. G. MILLS. *Chemical Engineering & Mining Review,* Vol. 28, Jan. 8, 1936, pages 94-98. A description of the development of the equipment used and the operations required in the production of Cu wire bars and refined shapes at the Electrolytic Refining Co. of Australia, Ltd., Port Kembla, N.S.W., particularly the application of pulverized coal firing. WHB (6)

The Manufacture and Use of Insulating Firebrick in the United States. F. H. NORTON. *Engineering,* Vol. 141, Feb. 7, 1936, page 162. From a paper read before the Refractory Materials Section of the Ceramic Society, London, Nov. 1935. LFM (6)

Bituminous Coal for Higher Temperatures in Open-hearth Furnaces. THEODORE NAGEL. *American Institute Mining & Metallurgical Engineers, Contribution* No. 100, Feb. 1936, 5 pages (mimeographed). Modern practice demands higher temperatures than can be produced by the usual producer gas. These have been produced with natural gas, coke-oven gas and fuel oil. The lower temperatures of combustion of producer gas are due to N_2 dilution at the gas producer. The paper contains new presentation of combustion thermo-chemistry, tabulations of the relative thermal values of gas fuels, and the relative costs and comparative values as applied to open-hearth practice. Production of producer gas with less N_2 dilution, generated from bituminous coal with an O_2-rich blast, is proposed and a method for generating this gas of higher thermal value is presented, including data for producing low-cost O_2 of 95% purity. The data are claimed to warrant the attention of bituminous coal producers and open-hearth steel operators. JLG (6)

Electric Annealing Furnaces and Their Heating Elements (Elektrische Glühöfen und ihre Heizelemente) W. ROHN. *Elektrowärme,* Vol. 6, Jan. 1936, pages 17-20. Electric annealing furnaces are divided into 5 groups, according to their operating temperatures: (1) up to 800° C., with heating elements of alloys with 15-20% Cr, 30-20% Ni, remainder Fe; (2) from 800° to 950° C., with elements of 15-20% Cr, 10-20% Fe, remainder Ni; (3) from 950°-1100° C., with Fe-free Ni-Cr elements of about 20% Cr, 80% Ni; (4) from 1100°-1250° C., elements of 20-30% Cr, 6-4% Al + Si, remainder Fe; (5) from 1250°-1450° C., here ceramic heating elements of silicon carbide must be used. The influence of furnace atmosphere, temperature change and dimensioning of the heating elements on their life, and economical considerations in the investment of higher or lower first cost are discussed. Ha (6)

The Behaviour of Refractory Materials Under Torsion at Different Temperatures—Kaolin and Kaolin-Silica Mixtures. A. L. ROBERTS & J. W. COBB. *Engineering,* Vol. 141, Jan. 31, 1936, page 133. From a paper read before the Refractory Materials Section of the Ceramic Society, London, Nov. 1935. LFM (6)

Refractories for Foundry Use. W. J. REES. *Engineer,* Vol. 160, July 19, 1935, page 72; *Engineering,* Vol. 140, Sept. 13, 1935, pages 289-290; *Mechanical World & Engineering Record,* Vol. 98, Aug. 9, 1935, pages 121-122. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 62R/4. LFM + WH (6)

Factors to be Considered in the Insulation of Open Hearth Furnaces. GILBERT SOLER. *Blast Furnace & Steel Plant,* Vol. 23, Nov. 1935, pages 799-800; *Heat Treating & Forging,* Vol. 21, Dec. 1935, page 592. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 62R/5. MS (6)

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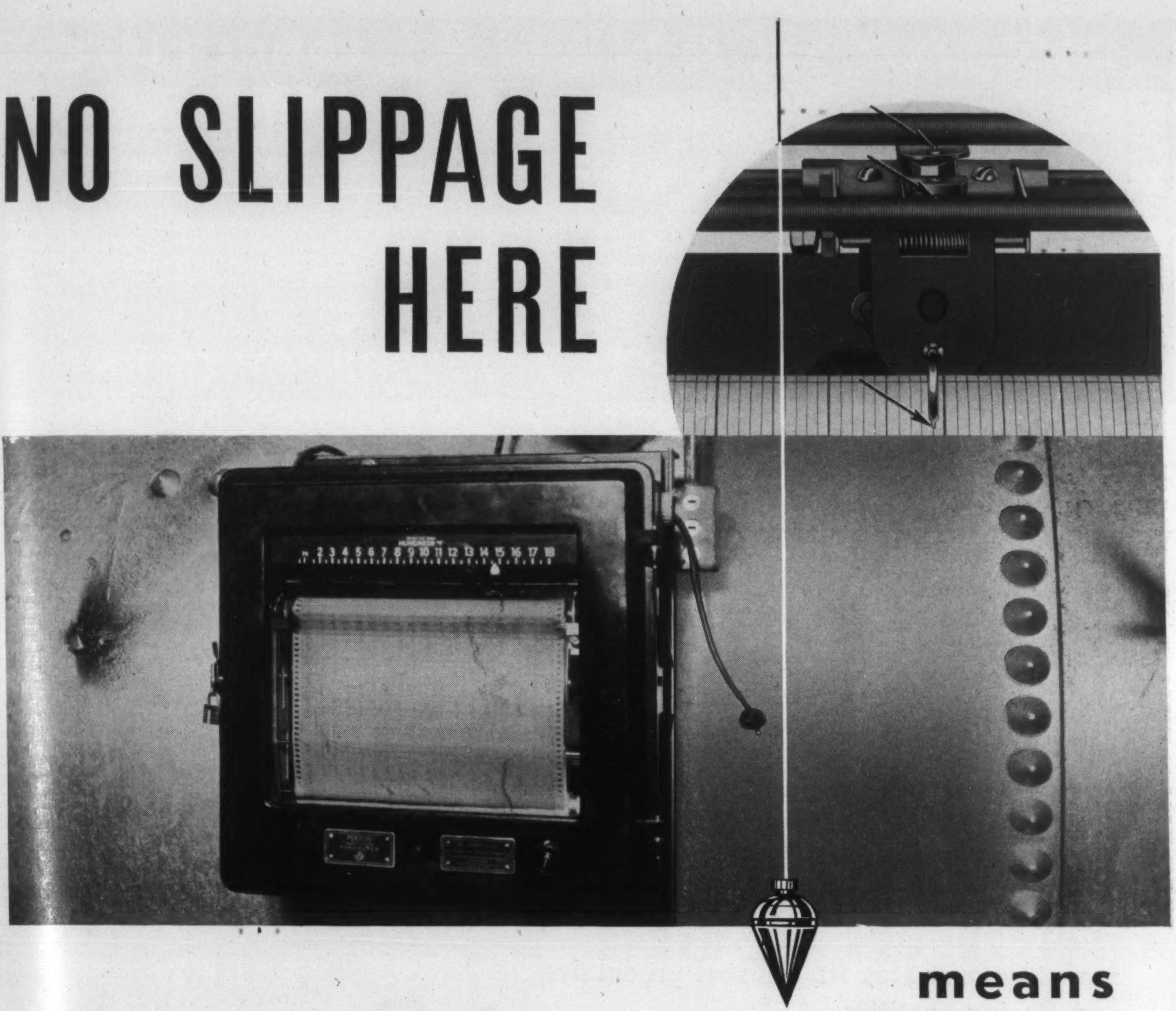

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Hydrogen Furnaces for Tube Parts. *Radio Engineering,* Vol. 16, Mar. 1936, pages 6-7. An illustrated description and discussion of pre-assembly processes for cleaning, brazing, and degassing radio tube parts. The importance of control in the operation of these furnaces is great—the temperature must be controlled within a very limited range, H flow must be sure and at a definite rate and the water passing through the cooling chamber must be held at a temperature which will maintain the cooling chamber above room temperature by the correct amount. WHB (6)

Gas Firing Improves Columbia Tool Steels. *Natural Gas,* Vol. 17, Jan. 1936, pages 8-9. Improvements in quality of finished product and reduction in scale losses have followed installation of completely controlled gas-fired furnaces for forging of tool steels. Time, temperature and atmosphere are automatically regulated, firing speed has been increased 500% and thermal efficiency 50%. Absence of smoke stack considerably lessens original cost of plant. FPP (6)

Acme Uses Modified "Laboratory" Slab Furnaces. *Iron Age,* Vol. 137, Feb. 20, 1936, pages 38-39, 51. Discusses the stabilization of heating operation attending a 16" hot strip mill at the plant of the Acme Steel Co., Riverdale works. Original installation consisted of 2 furnaces, but because of the variation in character of tonnage a third furnace was added. No. 3 furnace was of the laboratory type and results showed that the 3 furnaces gave different results. Therefore certain modifications were made in No. 3 furnace, and No. 1 and 2 furnaces were rebuilt in order to give similar results. Gives advantages of alterations. VSP (6)

Continuous Bright-Annealing and Normalising Furnaces for Steel Strip and Sheets. *Engineering,* Vol. 141, Apr. 3, 1936, page 369. Describes a bright-annealing furnace developed by Birmingham Electric Furnaces, Ltd. It is a continuous furnace for bright annealing and normalizing of hot and cold rolled strips and sheets intended for deep drawing and press work. Material is treated in a single layer, under accurately controlled conditions of temperature and atmosphere, and arrangement is such that the time-temperature cycle for any desired hardness is readily determined. VSP (6)

Normalising Rolled Steel Strips. *Electrical Review,* Vol. 118, Apr. 3, 1936, page 490. Stourbridge Rolling Mill has installed a continuous, electric bright-annealing furnace. It handles short lengths as well as coiled strip. Hourly output is 6 cwt. of material 0.020"-0.25" thick and up to 12" wide. Heating chamber is divided into 3 sections, temperature in each being independently and automatically controlled. Cooling chamber is H_2O jacketed. Reducing atmosphere is provided by burning coal-gas and air in a special generator. MS (6)

Small Cupola Constructed to Meet Delivery Requirements. CYRIL BRECKNOCK. *Foundry,* Vol. 63, Dec. 1935, pages 34-35. To reduce operating costs the Lorain Castings Co. constructed a small cupola lined to 24". It is mounted on a car-wheeled truck and charged from same platform as large cupola. To facilitate cleaning and preparing the cupola, it is made in sections. Approximately 5 tons of Fe can be melted satisfactorily. Unit was built primarily for emergency needs but now it is a vital part of foundry equipment. VSP (6)

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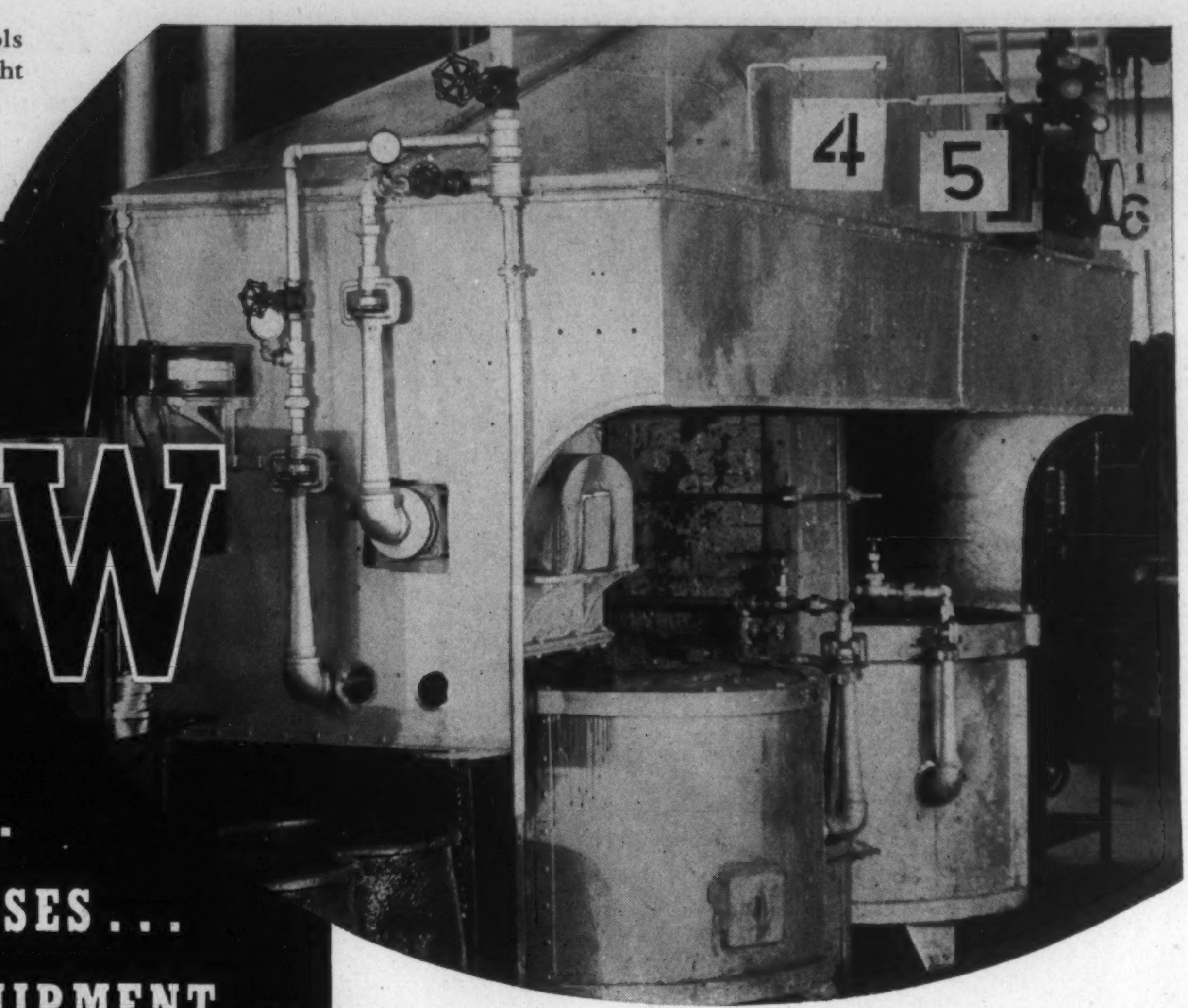
CINCINNATI, OHIO

Gas-fired lead pots showing controls and tell-tale lights at extreme right and indicating pyrometers at left.



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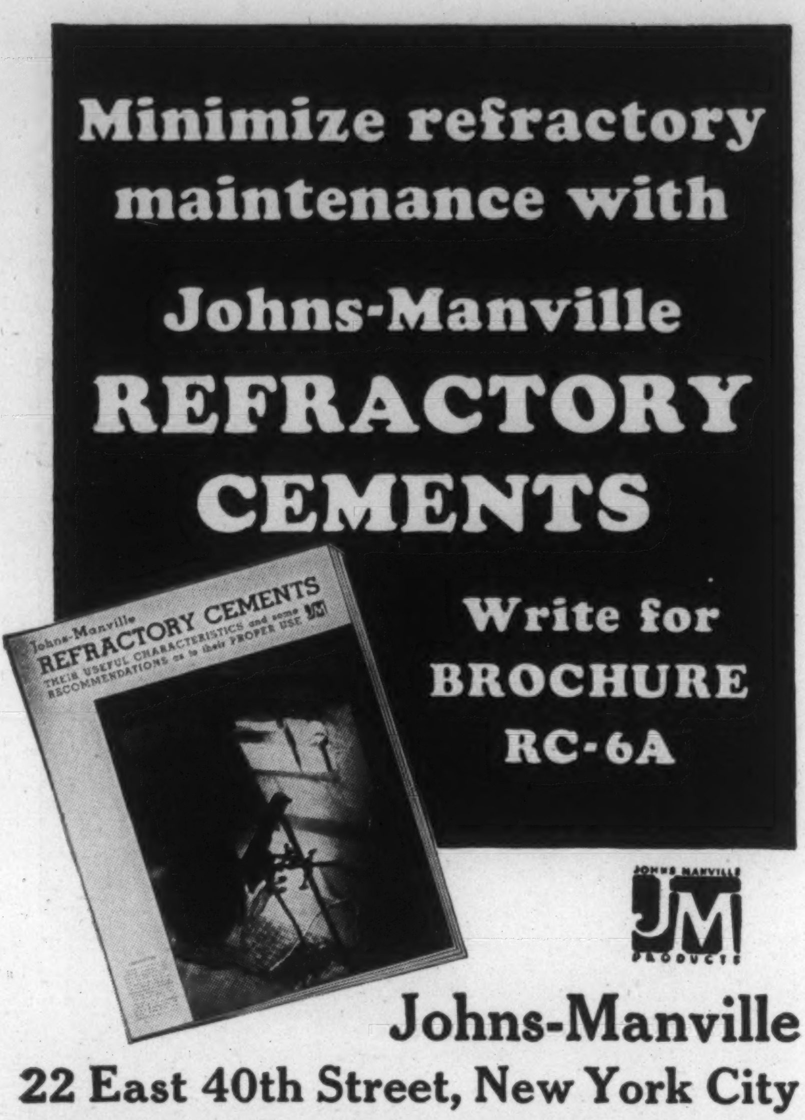

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Gas-Fired Furnaces for Forging Tool Steels. *Iron Age,* Vol. 137, Jan. 30, 1936, pages 32-33. Describes the first completely controlled gas-fired furnace for forging tool steels at the plant of Columbia Tool Steel Co., Chicago Heights, Ill. The success of the installation is based on a new conception of gas, which involves a recognition of the fact that gas is a valuable metallurgical chemical in addition to being a source of heat. Important advantages lie in the uniformity of product, improved working conditions, no smoke, etc. VSP (6)

The Action of Water Vapour on Silica Bricks at High Temperatures, and Its Possible Industrial Significance. A. G. Dodd. *Engineering,* Vol. 141, Jan. 31, 1936, pages 133-134. From a paper read before the Refractory Materials Section of the Ceramic Society, London, Nov. 1935. LFM (6)

Specific Heat of Gases as an Aid in the Calculation of Equilibria (Die spezifischen Wärmen der Gase als Hilfswerte zur Berechnung von Gleichgewichten) C. Schwarz. *Archiv für das Eisenhüttenwesen,* Vol. 9, Feb. 1936, pages 389-396. A review, particularly of the more recent American work. 24 references. SE (6)

The Blast Furnace Gas Engine in Central Europe. J. D. Watson. *Gas & Oil Power,* Vol. 30, Apr. 1935, pages 81-83. Discusses economics of blast furnace engine construction in German steel plants. Descriptions and diagrams are included of several types of large gas engines available. Because of the low calorific value of blast furnace gas, gas engine manufacturers resort to a system of scavenging and supercharging, claimed to bring the cost into line with that of the equivalent gas-fired boiler and turbine. FPP (6)

Malleable Foundry Duplexes With Cupola and Air Furnaces. *Foundry,* Vol. 64, Jan. 1936, pages 22-24, 63-64. Discusses reduction in production cost made by the Eberhard Mfg. Co., Cleveland, as a result of installing new melting equipment and changing method of distributing and pouring Fe and shaking out castings. The feature of new system is a duplexing unit in which metal is melted in a cupola and treated further in air or reverberatory type furnace fired with powdered coal. Operating at 60% of capacity, the daily heat is 60 tons. In daily operation of air furnace, coal consumption is 250 lb./ton of Fe. VSP (6)

Evaluation of Refractory Materials. The Adsorption Capacity of Refractory Clays and Kaolins (Sui metodi di collaudo dei materiali refrattori. La capacita di sorbzione delle argilli refrattarie e dei caolini) L. Belladen. *La Metallurgia Italiana,* Vol. 28, Feb. 1936, pages 59-64. The sorption capacities, T, of 7 refractories have been determined and compared with various physical properties. Plasticity, measured according to Rieke, increases with T. There is no relation between T and resistance to compression. The modulus of rupture by bending increases linearly with T. In general, shrinkage in drying increases with T, but some exceptions are noted. AWC (6)

Experiences with Special Cements (Erfahrungen mit Spezialzementen) Richard Grün. *Angewandte Chemie,* Vol. 49, Jan. 25, 1936, pages 85-95. The characteristic properties of cements, especially those used in metallurgical processes are described and their best application discussed. Ha (6)

7. JOINING

Flaring Experiments (Einwalzversuche) Block. *Die Wärme,* Vol. 59, Jan. 18, 1936, pages 33-39. Paper before the Zentralverband der Preussischen Dampfkessel Überwachungsvereine, Essen, May 1935, summarizes the speaker's and investigations by Berndt, Lang, Oppenheimer, Ries, Siebel, Jäntscha on the rolling-in of boiler tubes. A complete understanding of this joining method is still lacking and Bloch doubts that this will ever be possible. The flaring process, however, has been solved from a practical viewpoint with remarkable success. EF (7)

Tools for Rolling-In of Boiler Tubes (Werkzeuge zum Einwalzen von Rohren) Helmut Werkmeister. *Die Wärme,* Vol. 59, Jan. 11, 1936, pages 19-26. Paper before the Zentralverband der Preussischen Dampfkessel-Überwachungsvereine, Essen, May 1935, points out that welding and flaring represent the most important tube joining methods in boiler construction. Scientific investigations have advanced the rolling-in process to a remarkable degree. The development of the rolling-in equipment is traced and the latest German facilities are fully described and illustrated. EF (7)

Joining of Aluminum Cables (Herstellung der Aluminiumleiter-Verbindungen bei Kabeln) *Elektrizitätswirtschaft,* Vol. 34, Oct. 5, 1935, pages 633-638. Discusses (I) properties of Al, (II) joining methods of Al power lines by (a) clamps, (b) soldering, (c) welding, including gas, electric and "cast welding." The latter method was introduced in 1935 by a large German concern. A provisional mold is formed around the 2 cable ends to be joined and Al heated to 850° C. is cast into the mold. Mold and excess metal are removed. Bending tests proved that each strand is solidly fused into the joining block of Al. Detailed information is given on this novel joining method. WH (7)

Welding Applications Extended. *Steel,* Vol. 98, Jan. 6, 1936, pages 214, 216, 318-320. Review of progress made in welding and riveting during 1935, as seen by various authorities. MS (7)

■ 7a. Soldering & Brazing ■

C. H. CHATFIELD, SECTION EDITOR

The Development of Low-Melting Point Solders. *Engineering,* Vol. 140, Dec. 27, 1935, page 686. Brief summary of the experimental work carried out during the past few years on solders having melting points ranging from 250° to 550° C. One class of these solders contains Sn and from 5 to 20% Ag and the melting point ranges from 300° to 400° C. The Pb-Ag system has also been used, especially the alloys in the region of the eutectic containing 2.5% Ag which solidify at 303° C. and are fluid at 375° C. It is necessary to use a low-melting flux with these alloys such as $ZnCl_2$ but this is not an ideal flux for the purpose. LFM (7a)

Gold Solders (Goldlote) K. Bihlmaier. *Mitteilungen der Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 9, Nov./Dec. 1935, pages 85-90; Jan. 1936, pages 99-106. Qualities of a good solder for Au and Au alloys are discussed. The basis of industrially used Au alloys are the Au-Ag-Cu alloys, to which nowadays Zn and Cd are added to obtain certain color hues or to reduce the sp.gr. of the alloy as much as possible. Curves are given for the range of melting points of Au-Ag alloys of different Au content and complete tables are given for the composition of solders with a fineness of 750, 585, and 333 parts Au. The preparation of the solders is described in full as the correct melting process and addition of the components is of great importance. 14 references. Ha (7a)

Soldering of Aluminum Cables and Ropes with a Soft-solder Paste (Ueber das Löten von Aluminiumseilen und -kabeln mit einer Weichlotpaste) W. Nicolini. *Aluminium,* Vol. 17, Dec. 1935, pages 648-650. The soldering paste (Alutinol) is composed of 40% Sn, 40% Zn and 20% Cd; it is used with a flux. Tests showed good mechanical properties of the joint which can also be easily worked and has a good electrical conductivity. The soldering procedure is described. Ha (7a)

The Penetration of Steel by Soft Solder and other Molten Metals at Temperatures up to 400° C. L. J. G. van Ewijk. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 241-256. Includes discussion. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 362R/3. (7a)

The Proportions and Properties of Silver Solders. H. N. Bassett. *Mechanical World & Engineering Record,* Vol. 98, Sept. 6, 1935, pages 217-218, page 222. Two tables list analyses of British, German and American silver solders and the effects of impurities such as Cd, Sn, Ni, Pb and Fe are discussed. Experimental work on the effect of Mn, Si and P is underway. Physical properties (fluidity, malleability, strength, corrosion resistance) are fully considered and the joining of various non-ferrous materials are dealt with at length. WH (7a)

Brazing New Type Tear Gas Shells in Controlled Atmosphere. *Iron Age,* Vol. 137, Feb. 20, 1936, pages 37-51. **Tear Gas Projectile Electric Furnace Brazed.** *Heat Treating & Forging,* Vol. 22, Mar. 1936, pages 131-132. Describes the electric furnace brazing, with controlled atmosphere, of a new type of gas shell developed by Lake Erie Chemical Co. Parts to go into construction of shell are brazed. Cu brazing is done at 2100° F. in 20 kw. box type furnace with automatic temperature control. Furnace has combustion type atmosphere control which reforms mixture of natural gas and air and which supplies a reducing atmosphere. Brazed joints have withstood hydrostatic pressure of 3000 lb./in.^{2} VSP + MS (7a)

Chemicals in Metal Working. *Chemical Trade Journal & Chemical Engineer,* Vol. 97, Oct. 11, 1935, pages 303-304. See "Solder", *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 65L/6. MS (7a)

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

Alton Reconditions 150,000 Rail Ends in 4 Months Time: How the Welding Was Done. M. H. DICK. *Railway Engineering & Maintenance*, Vol. 32, Jan. 1936, pages 17-20. An extensive rail and repair program necessitated by inauguration of high speed passenger service involved 239 track miles of 90 lb. rail and 6 miles of 100 lb. rail. Large, well-organized gangs, togther with use of fast welding technique resulting in high output per welder, assured low average cost per joint welded. Technique described is "straight-line" method, in which metal is applied progressively away from the welder in patches one-half as wide as the rail head. Additional advantage claimed for "straight-line" method is the harder rail-end obtained. FPP (7b)

Hard Facing. DON LLEWELLYN. *Mill & Factory*, Vol. 18, Apr. 1936, pages 70, 136-137. Hard facing of machine parts with welded-on overlays is constantly increasing in application and importance. Large maintenance cost reductions arise from longer life, fewer replacements, salvaging of used parts, saving in power consumption, and increases in operating efficiency. Cheaper base metals may be used for wearing parts. According to specific wear, corrosion or temperature conditions, 4 groups of hard facing materials are available, all applied by either electric or oxy-acetylene methods: (1) tungsten carbide, (2) tungsten carbide imbedded in a mild steel matrix, (3) cast alloy and (4) mild steel mixed with powdered alloys, which when deposited become self hardening. Welding technique is described in some detail. FPP (7b)

Repair of Cracked Bronze Bells by Welding (Wiederherstellung gesprungener Bronzeglocken durch Schweissung) P. BRÄUER. *Autogene Metallbearbeitung*, Vol. 29, Mar. 15, 1936, pages 85-88. The average life of a church bell is about 300 years; the continuous impact of the clapper at the same place causes a cold deformation and internal stresses in the metal which lead to fatigue fracture. Inspecting for fine cracks and repair procedure are explained, and repairs on bells up to 3500 kg. weight are described. Careful heating is absolutely necessary and it must proceed very slowly. Tests have shown that welded bells always had a purer and fuller tone than the unwelded bell. Ha (7b)

New Design of Spot Welding Electrodes. G. KOMOVSKI. *Sheet Metal Industries*, Vol. 9, Sept. 1935, pages 585, 588. See *Metals & Alloys*, Vol. 7, Jan. 1936, page MA 18R/10. AWM (7b)

Modern Methods of Welding. R. S. KENNEDY. *Welding Journal*, British, Vol. 32, Nov. 1935, pages 337-338. General discussion of various phases of arc and flame welding. WB (7b)

Built-up Jigs and Fixtures offer Many Advantages. F. J. BURNS. *Modern Machine Shop*, Vol. 8. Dec. 1935, pages 40-44, 68. Examples show the advantages of welding for these tools. Ha (7b)

Hydrocarbon Fuel Gases for Cutting. GEORGE V. SLOTTMAN. Presented at 36th Annual Convention, *International Acetylene Association*, Nov. 12-15, 1935, 11 pages. Available in mimeographed form from the offices of the Association, 30 East 42nd Street, New York, N. Y. Describes series of practical cutting tests using propane and other hydrocarbon fuel gases, in comparison with acetylene. A greater volume of propane than acetylene was required for the same amount of cutting and the total quantity of O_2 used with propane was considerably greater. Optimum ratios of O_2 to fuel gas in preheating flames were found to be: city gas, 0.75 to 1; natural gas, 2.0 to 1; propane 4.5 to 1; acetylene 1.7 to 1. It was concluded that, at present prices for O_2 and fuel gases, acetylene is the most economical for steel cutting. EVD (7b)

Welding in Rolling Stock Construction. *Commonwealth Engineer*, Vol. 23, Jan. 1, 1936, pages 171-175. This articles describes some of the ways in which welding has been applied by the Victorian railways department in welding rolling stock construction. Improved design and great economy of construction has been achieved by the use of electric welding in the fabrication of buffers, draft gear, automatic couplers, wagon frames, locomotive tenders and car bodies. WH (7b)

An All-Welded Factory Building. *Commonwealth Engineer*, Vol. 24, Dec. 2, 1935, pages 139-142. An illustrated account of the design and construction of a steel framed factory building erected recently in Deer Park, Vic., Australia. The framework was specially designed for fabrication by electric welding and the adoption of this method of construction resulted in a particularly light and economical design. As much as possible of the fabrication was done in the workshop, reducing field welding to a minimum. No difficulties were encountered during erection. WH (7b)

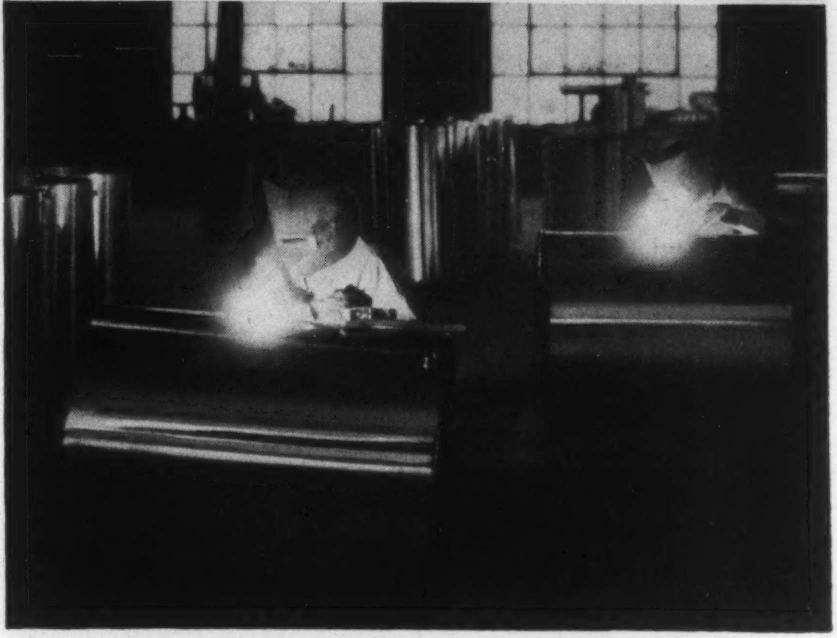
A New Welding and Galvanizing Factory. *Industrial Chemist*, Vol. 11, Aug. 1935, pages 312-314. A brief description of the welding and galvanizing works of Robt. Jenkins & Co., Ltd., Rotherham, England. RAW (7b)

Rebuilding Worn Engine Parts. *Journal of Commerce, Shipbuilding & Engineering Edition*, Nov. 14, 1935, pages 1, 3. A discussion of the application of bronze welding in repair work deals with the composition of various types of welding rods and of the bronze-Si rod in particular, and of the better results obtained from its use. The building up of worn reciprocating parts such as pistons and valves are considered, and the advantages claimed for the bronze-welded rebuilding of pistons is fully discussed from the point of view of cost, methods of procedure, high temperature conditions, and various physical conditions such as severe alternations and repeated stresses. JWD (7b)

Torch Cutting Improves—Design Benefits. *Machine Design*, Vol. 7, Dec. 1935, pages 35-36. Largely refers to statements by E. V. David, James Grant & W. J. Priestley at the Annual Meeting of the International Acetylene Association at Cleveland. WH (7b)

Railway Wagons Sixty-Eight Feet Long with an All-welded Underframe. *Welder*, Vol. 8, Dec. 1935, pages 769-772. The design and welding methods used are described in detail. Ha (7b)

Monel Metal
WELDS
VS
Carbon-Tetrachloride
CORROSION



Carbon-arc welding the Monel Metal tanks for the "Lustrlux" Dry Cleaning System, Butler Mfg. Co., Kansas City, Missouri.

Monel Metal dry-cleaning machines resist attack by the new chlorinated hydrocarbon solvents

IN dry-cleaning machines for use with the new chlorinated hydrocarbon solvents, such parts as tanks, washer shells, condenser-bodies, pressure filters and vapor piping are made of Monel Metal.

Carbon-arc welding is particularly well adapted to the fabrication of the comparatively light gauges (16 and 18 ga.) used in the construction of Monel Metal dry-cleaning equipment in which the seams must be practically as corrosion-resistant as Monel Metal itself.

The following pointers for your operators show the extreme simplicity of carbon-arc welding 16- to 18-gauge Monel Metal sheet:

The polarity should be straight. Use small-diameter carbons (5/32, 3/16 or 1/4"), and to obtain better control of arc, taper them to pencil point for 2".

Keep the heat relatively low, and obtain a uniform, smooth flow with a short arc.

Use coated carbon-arc welding rod (INCO Carbon-Arc Monel Metal #20), and feed rod separately. Don't puddle.

This procedure avoids porosity, cracking... gives uniform penetration.

Information on welding problems relative to Monel Metal, Nickel or Nickel-Clad Steel gladly supplied.

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"HARDWELD"—High-carbon electrode—for building up worn surfaces—produces dense, tough deposit of moderate hardness, to resist shock and abrasion.

"WEARWELD"—A shielded-arc electrode for refacing parts subjected to rolling or sliding, batter, sand-abrasion and repeated impact. Unusually hard, tough deposit.

"ABRASOWELD"—For building up straight-carbon steel, low-alloy steel or high-manganese steel surfaces where pronounced battering and impact are not encountered. Deposit is self-hardening—highly resistant to corrosion.

"TOOLWELD"—Coated electrode for building super-speed cutting edges on cold rolled stock. Users report deposit lasts even longer than high-cost tool steel. Also used for refacing worn cutting edges on cutting tools, dies, etc., of high-speed steel.

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Welding an 80 Inch Steel Belt. HENRY W. YOUNG. *Welding Engineer,* Vol. 21, Jan. 1936, pages 27-28. A belt of tempered, high C steel of Rockwell hardness 44, 51 ft. long, of 0.072″ thickness, is made up of five 16″ strips butt welded edge to edge in a special clamping machine. The total pull transmitted is 600,000 lbs. Ha (7b)

Tool Equipment and Machine Parts Built by Torch Cut and Weld Method. P. H. DANLY. *Iron Age,* Vol. 137, Jan. 16, 1936, pages 28-31. See "Fabricating Tool Equipment and Machine Parts by the Torch Cut and Weld Method," *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 68R/3. VSP (7b)

The Repair of Small Boilers and Pressure Vessels. F. A. GLIDEWELL. *Journal & Record of Transactions Junior Institution of Engineers,* Vol. 45, Sept. 1935, pages 497-507. See *Metals & Alloys,* Vol. 6, July 1935, page MA 286R/7. WH (7b)

Autogenously Welded Rail Joint; the Böhler X-joint (Autogengeschweisste Schienenstossverbindung; der Böhler-X-Stoss) H. MELHARDT. *Autogene Metallbearbeitung,* Vol. 29, Jan. 15, 1936, pages 17-27. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 497L/4. Ha (7b)

Welded Chemical Plant. N. P. INGLIS & W. ANDREWS. *Chemical Trade Journal & Chemical Engineer,* Vol. 97, July 5, 1935, page 7. See "Welding in the Chemical Engineering Industry," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 402L/9. MS (7b)

Gas Welding Aluminum and Its Alloys. G. O. HOGLUND. Presented at 36th Annual Convention, *International Acetylene Association,* Nov. 12-15, 1935, 11 pages. Available in mimeographed form from the offices of the Association, 30 East 42nd Street, New York, N. Y. Welding of common and heat-treated Al alloys. Welded Al in architectural and dairy applications, in the field of transportation and in chemical handling equipment. EVD (7b)

Three Profits from Welded Fabrication. *Industry & Welding Quarterly,* Dec. 1935, pages 179-180. Advantages of welded over cast and other fabricated structures from the point of strength, appearance and economy. Ha (7b)

Welding in Relation to the Manufacture of All-steel Automobile Bodies. J. C. ARROWSMITH. *Symposium on Welding of Iron & Steel,* May 2 & 3, 1935, *Iron & Steel Institute,* Vol. 1, pages 465-472. Describes different methods of welding automobile bodies as used in England. See also *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 496R/6. JLG (7b)

Industry Adopts Many New Uses for Oxyacetylene. E. V. DAVID. *Steel,* Vol. 97, Nov. 4, 1935, pages 71-73. Progress report of the Oxyacetylene Committee of the International Acetylene Association. Oxyacetylene flame is finding increased use in automobile manufacture, welding of piping, bronze welding of ferrous metals, welding of stainless steels, hard-facing, Ag soldering, metal spraying, machine gas cutting of steel parts, and scrapping. Oxyacetylene process is largely responsible for lighter-weight machines and products. Lists codes and rules issued recently and technical pamphlets prepared by the Committee. MS (7b)

Bicycle Manufacturers Use Resistance Welding to Improve Their Product. *Steel,* Vol. 97, Sept. 23, 1935, pages 58, 62. From *Flashes,* published by Thomson-Gibb Electric Welding Co., Lynn, Mass. Presents details of design for fabrication of bicycles by flash welding. Process is being used to a large extent to cut down weight without loss of strength, improve appearance, and reduce costs. MS (7b)

Skates Made by Resistance Welding. *Steel,* Vol. 97, Sept. 16, 1935, page 31. From *Flashes,* published by Thomson-Gibb Electric Welding Co., Lynn, Mass. Some ice skates are made by roller seam welding high-C steel blade into position in tube member of alloy or stainless steel. Recent type has tubular member folded back and seam welded along edges to form blade. Projection welding is now used to join wheel trucks of roller skates to the body. MS (7b)

Steel Bars and Channels are Cut with Oxyacetylene Flame on New Machine. *Steel,* Vol. 97, Sept. 9, 1935, page 47. Describes fabrication of steel foundry flasks by Sterling Wheelbarrow Co., Milwaukee, Wis. MS (7b)

Steel Tube Manufacture. *Commonwealth Engineer,* Vol. 23, Sept. 2, 1935, pages 41-47. The article describes in some detail the equipment and processing at the Stewarts & Lloyds Pty., Ltd., of Newcastle, N.S.W., dealing not only with the actual work involved but also with such matters as control of furnace and heat recuperation. The heating and welding of the tube, cutting into lengths, finishing, screwing and manufacture of couplings are all carried out by automatic machinery without any handling by hand. WH (7b)

Studies the Weldability of Copper Alloys. *Machine Design,* Vol. 7, Oct. 1935, page 39. Resistance welding current requirements are in direct proportion to the conductivity of the metals to be welded. Replacing Zn by Mn, Si, Sn and Ni improves weldability of brass. Al only up to 3% acts similarly. An 85/15 and 90/10 Cu-Sn alloy is also suited for resistance welding. WH (7b)

The Welding of Chromium Steels in Chemical Plant Equipment. J. R. DAWSON. *Canadian Chemistry & Metallurgy,* Vol. 19, Dec. 1935, pages 337-338. Seven groups of Cr steels are as follows:

Group	% Cr	% C	% Ni
1	12 — 17	over .20	
2	11 — 14	less than .12	
3	15 — 18	less than .12	
4	20 — 30	less than .30	
5	17 — 25	less than .20	7 — 12
6	7 — 25	less than .20	17 — 22
7	Castings — considerable variation of composition.		

The rods chosen in oxy-acetylene welding should be as nearly as possible of the same composition as the materials being welded. A smaller flame should be used on stainless steels than on ordinary steels to avoid overheating of the weld. X-ray examination and the free bend method of testing for ductility have been of great value in checking up on welded products. The selection of the correct steel and procedure for welding for each type of service are important. WHB (7b)

Endurance of Welded Assemblies (Considérations sur l'Endurance des Assemblages Soudés) H. Dustin. *Revue Universelle des Mines,* Vol. 11, Dec. 1935, pages 521-531. Results of tests of fatigue strength made in recent years with most modern machines on welded structures are analyzed. Behavior of modern structural steels, different kind of welded joints, and the stress distribution in the joints are determined and results shown in curves. In general it was found that the fatigue strength as compared with the stresses determined by the load test of bridges had a safety factor of about 2. Furthermore, the endurance limit should never be determined by theoretical or analytical means:—a thorough knowledge of the practical endurance limits of the different types of welded joints is of greater importance. Ha (7b)

1

Welded Piping and Pressure Vessels in the Marine Field. J. W. Wilson. Presented at 36th Annual Convention, *International Acetylene Association,* Nov. 12-15, 1935, 4 pages. Available in mimeographed form from the offices of the Association, 30 East 42nd Street, New York, N. Y. Welded boilers and pressure vessels have been approved by the Bureau of Navigation and Steamboat Inspection. Several installations are in successful operation at pressures up to 450 lb./in.^{2} gage and total temperatures up to 750° F. However the Welding Code of the Bureau now permits welded piping for 100 lb./in.^{2} only. Careful thought and study is now being given to the development of a Code for welding high pressure piping in position on shipboard. Marine piping is subjected to harder usage than stationary plant piping. In addition to usual stresses, it must withstand indeterminate stresses due to rolling and pitching of vessel in a seaway, causing severe twisting, buckling, bending and pulling. Nevertheless welded piping on *S.S. Dixie* remained intact when vessel recently grounded on Florida reef in hurricane which pounded the vessel and placed terrific strains on piping. Not a weld cracked and there were no signs of leakage or distress. EVD (7b)

2

3

Welding of Glider Parts (Geschweisste Bauteile von Segelflugzeugen) V. Walter. *Autogen-Schweisser,* Vol. 8, Oct. 1935, pages 114-117. Stressing the gradual replacement of wood by high-grade steel (tubing) as structural material for sailplanes, the significance of gas welding as joining method in regard to structural stability and low weight is emphasized. The German welding specifications for this utilization of welding are cited and some welded members of gliders are discussed and illustrated. WH (7b)

4

Built-up Welding of Copper (Kupfer-Auftragschweissung) Viktor Walter. *Der Autogen-Schweisser,* Vol. 8, Sept. 1935, pages 100-104. Mainly deals with the built-up welding of highly stressed electrical contacts made of Cu and its alloys. Precautions to be observed when gas welding Cu are pointed out. WH (7b)

Applications of Oxy-Acetylene Welding (Les Applications de la Soudure Oxy-Acétylénique) *Revue de la Soudure Autogène,* Vol. 27, Dec. 1935, pages 2-3. Typical new applications are illustrated. FR (7b)

5

New Data Tables for Oxy-Acetylene Welding (Nouveau Barême de Soudure Autogène Oxy-Acétylénique) *Revue de la Soudure Autogène,* Vol. 28, Feb. 1936, pages 2-9. For each kind of welding and for each possible thickness following data are given: number of nozzle to be used, diameter of added metal rod, number of linear meters which can be welded during an hour, consumption of acetylene in liters per meter, consumption of oxygen in liters per meter, weight of metal used. Foregoing data are given for welding of steel, and special directions are given for welding other metals, i.e. Cu, brass, Al, cast Fe, Ni, Monel metal, nickel silver, stainless steels, Pb. Last section gives data for gas cutting of steel. FR (7b)

6

Structural Welding Progress in 1935. *Welder,* Vol. 8, Jan. 1936, pages 807-810. Some welded bridges and structures recently erected in Germany are reviewed. Ha (7b)

British Standards Institution—New Specifications. *Welding Journal,* British, Vol. 32, Dec. 1935, pages 371-372. Review of specifications for Rating of Electric Arc Welding Plant and equipment and for welding accessories, No. 638—1935, Covered Electrodes for metal arc welding wrought iron and mild steel, No. 639—1935, Bare rod or wire Electrodes for metal arc welding wrought iron and mild steel, No. 640—1935, B. S. Specification for carbide of calcium (graded sizes), No. 642—1935, B. S. specification for the use of structural steel in building, No. 449—1935. WB (7b)

7

New Matters in Welding (Nouveautés en soudure) R. Granjon & J. Brillié. *Revue de Métallurgie,* Vol. 33, Feb. 1936, pages 89-95. Sketch of new applications of welding occurring within the last few years. JDG (7b)

Work of French Acetylene and Fusion Welding Organizations (Travaux des Organismes de l'Acetylène et de la Soudure Autogène) R. Granjon. *Revue de la Soudure Autogène,* Vol. 28, Jan. 1936, pages 1-4. Reviews what has been done in France during last year in welding, teaching welding, laboratories, lectures, industrial control, publications, specifications, congress, etc. FR (7b)

8

Study of Tentative French Specifications on Welding of Bridges and Overhead Structures (Analyse de la Circulaire du 25 Juillet 1935) A. Goelzer. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 6, Nov.-Dec. 1935, pages 1979-1989. Lecture before the French Welders' Society. Describes numerous recent applications of welding, chiefly as to bridge construction in various countries. FR (7b)

9

Major Equipment Repaired by Welding. *Canadian Machinery,* Vol. 46, Nov. 1935, pages 33-34. Discussion and photos of bronze weld repair job on ferrous machine housing casting. WB (7b)

Standard Specifications for Electric-Resistance-Welded Steel Pipe. *American Society for Testing Materials,* A. S. T. M. Designation: A135-34; *American Standards Association,* A. S. A. No.: B36.5-1935, 6 pages. AHE (7b)

10

Tentative Specifications for Electric-Fusion-Welded Steel Pipe (Sizes 8 in. to but not including 30 in.). *American Society for Testing Materials,* A. S. T. M. Designation: A139-34T; *American Standards Association,* A. S. A. No.: B36.9-1935, 6 pages. AHE (7b)

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8. FINISHING

H. S. RAWDON, SECTION EDITOR

■ 8a. Pickling ■

Diffusion of Hydrogen Through Steel During Electrolytic Pickling (Wasserstoffdurchlässigkeit von Stahl beim elektrolytischen Beizen) W. BAUKLOH & G. ZIMMERMANN. *Archiv für das Eisenhüttenwesen,* Vol. 9, Mar. 1936, pages 459-465. The H_2 passing through a low C steel sheet 0.64 $dm.^2$ in area on electrolytic pickling was determined. Hydride formers like As, Sb, P, Bi; and Se, Te, S; greatly increased the diffusivity and the presence of these elements in the pickle bath no doubt influences pickling embrittlement and blisters. Hg, Zn and Cd, also increase the diffusivity of H_2 in Fe. However, the hydride formers did not influence the diffusivity of H_2 through Ni, Cu, Zn, Al and Mg sheets. SE (8a)

Corrosion After Pickling Major Source of Galvanizer's Dross. WALLACE G. IMHOFF. *Iron Age,* Vol. 136, Dec. 5, 1935, pages 30-33, 116, 118; Vol. 137, Feb. 20, 1936, pages 30-33, 51. Discusses the reducing action of molten Zn at galvanizing bath temperatures on $FeSO_4$, $FeCl_2$, water rust and Fe_2O_3 formed on surface while drying. A second installment discusses the same action, under some experimental conditions, on $FeO.Fe_2O_3$. VSP (8a)

■ 8b. Cleaning including Sand Blasting ■

The Electrolytic Cleaning of Exhaust Valves. S. D. HERON, GEORGE CALINGAERT & F. J. DYKSTRA. *S. A. E. Journal,* Vol. 37, Dec. 1935, pages 19-21. Removal of engine carbon, scale and Pb compounds, etc. from valves without removal of underlying metal is accomplished by electrolysis in molten mixture of 60:40, $NaOH:Na_2CO_3$, the valve being the cathode with a storage cell discharging 6 amps. through the system. Entire removal of Pb may require anodic treatment in same bath for a short time subsequently to cathodic treatment. Precautions are to degrease, remove oil, and have dry surface before placing valve in molten mixture. Several representative photos are shown. WB (8b)

Improvements in Sand-Blasting Equipment. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 44-46. Rotary-table automatic sand-blast installations are briefly described. JCC (8b)

■ 8c. Polishing & Grinding ■

The Grinding of Milling Cutters. A. H. PREY. *Machinery,* N. Y., Vol. 42, Jan. 1936, pages 305-308. A detailed review of grinding methods with the view of obtaining best results in milling operations. Ha (8c)

Grinding Irregular Contours. *Machinery,* London, Vol. 47, Oct. 24, 1935, pages 97-98. Finish grinding of punches, dies, form tools and gages is discussed. Special shaped grinding wheels are used for precision grinding of contours. Steps in finishing are shown. WB (8c)

■ 8d. Electroplating ■

Imperfections in Electrodeposits. Studies in the Electrodeposition of Cobalt. A. CHAYBANY. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Oct. 25, 1935, pages 423-426. Author has endeavored to find the causes of pores and pinholes in electrodeposits for the purpose of suppressing, if possible, their formation. The details of the study and a résumé of the results of a number of other tests by the author are described. Pure Co salt was first prepared and from it a bath. Test results are given for a neutral bath, for a bath acidified with N/5 H_2SO_4, and for a bath acidified with C.P. HF & C.P. HCl. No pin holes and very few pores were observed when deposits were tested with $K_3FE(CN)_6$. The method used to prepare a less pure salt is described. Brittle deposits, pinholes and pores were found in electrodeposits in baths prepared from this salt. Upon analysis, traces of Ni, Fe, Cu, Pb and As were found in the Co salt. The effect of As, tested by a number of different methods, was studied. The author presents a hypothesis regarding the form in which he believes the As separates from the bath. The conclusion is reached that a large number of imperfections in deposits can be attributed to the presence of feeble traces of As. HBG (8d)

Electrodeposition of Tin. A. L. SHIELDS. *Monthly Review, American Electroplaters' Society,* Vol. 22, July 1935, pages 15-34. An account of the Sn plating process used by Westinghouse for evaporator units for refrigerators. Electro Sn was chosen rather than hot-dipped Sn because of lower metal consumption, uniformity and purity of coating. Plating solution contains Na stannate 6 to 12 oz./gal., NaOH 1.75 to 2.25 oz./gal. Since anode efficiency is low, it is necessary to add metal as stannate. Periodic additions of acetic acid keep NaOH which forms from building up to a high concentration. Temperature 160° to 170° F. Cathode current density 20 to 25 $amps./ft.^2$ A deposit .0005" to .0006" thick is obtained in 30 to 35 minutes. Other operating details, and methods of analysis for Sn and NaOH are given. The plated evaporators are tested in an atmosphere of ammonia. Weak spots turn blue in a few minutes. A good deposit will stand 4 to 16 hours test before breakdown. A bibliography and 9 pages of discussion are included. GBH (8d)

A Modern Electroplating Plant. *Mechanical World & Engineering Record,* Vol. 48, Dec. 6, 1935, page 549. A new plating plant for steel products has separate departments for polishing and preparation, general plating and Cr plating and a central section which combines plating, laboratory and administration. WH (8d)

Motion of a Liquid Around an Obstacle During Electro-deposition. E. P. HARRISON & H. GOLLOP. *Natnre,* Vol. 137, Feb. 8, 1936, page 234. Stream lines are found in Cu electrodeposits when the cathode is moved through the electrolyte. The phenomenon may be used to make a permanent record of the motion of the liquid past obstacles. CSB (8d)

Microscopic Measurements of Metallic Coatings. C. E. HEUSSNER. *Monthly Review American Electroplaters' Society,* Vol. 23, Jan. 1936, pages 5-23. The microscopical method of measuring coating thickness has the following advantages: (1) measures thickness at any desired point thus disclosing the weakest area of the deposit, (2) gives absolute figures on the distribution of the deposited metal, (3) shows other properties of the deposit such as adherence to the basis metal, impurities, and porosity. The specimen, held in a clamp, is polished by usual metallographic methods. Suggested procedure: first step, rough grinding on a #50 emery wheel, at 1800 r.p.m., second step, #280 emery paper mounted on a revolving steel disc., final step, on #400 emery paper. If desired, a finish polish can be obtained on a broadcloth wheel with levigated alumina. Etching brings out the electroplated layer. If the basis metal is steel or Zn, the etchant is 3% (by vol.) HNO_3 in ethyl alcohol. If basis metal is brass or bronze, etchant is 1 part (by vol.) NH_4OH and 1 part 10% H_2O_2. The measurement is made by means of a filar micrometer eyepiece mounted in a standard microscope, at a magnification of about 500 diameters. GBH (8d)

Technological Developments in the Plating Industry. C. B. YOUNG. *Metal Cleaning & Finishing,* Vol. 7, Apr. 1935, pages 165-168. Several developments are briefly described. Electrogalvanizing of steel wire is now commercial. The pure Zn coating will not crack or peel when the wire is bent on its own diameter, and is more resistant to corrosion than hot galvanized wire. A process for increasing the corrosion resistance of Zn consists in electrolyzing Zn-plated articles in a chromic acid plating solution with low voltage a.c. The Zn becomes deep black in color. Re deposition has been accomplished from aqueous solutions. It has been deposited from a cyanide solution containing glucose. Motor oils are being marketed in cans made from steel electroplated with Cu, a product which is as durable for the purpose as Sn plate and much cheaper. GBH (8d)

Examination and Supervision of Nickel Baths and the Analyses of Salts for Nickel Baths (Die Untersuchung und Ueberwachung von Nickelbädern und die Analysen von Nickelradsalzen. I.) E. RAUB & K. BIHLMAIER. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 9, Oct. 1935, pages 61-68. The difficulties of chemical investigation of Ni plating baths are pointed out and the factors influencing the quality of the deposits discussed. The most harmful impurities in the bath are Cu, Fe, Zn, Cd and Cr. Cu is deposited on the anode in the idle cell and gives a reddish hue to the Ni deposit. It is easily eliminated by letting the bath work for some time at low voltage. Fe is detected by citric acid. Its elimination is difficult; the best method is to precipitate it as hydroxide (see also *Mitteilungen Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 8, 1935, pages 1 and 17). Zn causes streaks in the deposit and poor adhesion. It is eliminated as basic Zn salt. Cd causes similar defects and is eliminated with difficulty. The most convenient way is to dilute the bath until the harmful effect is no longer noticed; at the same time more Ni salt is added. Cr does not occur often as impurity in Ni baths but can in even very small amounts entirely prevent Ni deposition. Its elimination is difficult especially when present as chromic acid. It is eliminated as chromic salt. Oils and fats especially in colloidal form, are only eliminated by operating the bath for a longer time so that they precipitate or disintegrate. Oxidizing agents are used to correct formation of pits in the deposits. Methods for routine supervision of the correct composition of the bath are described. **The Quantitative Determination of Boric Acid and Citric Acid (Die quantitative Bestimmung von Borsäure und Zitronensäure. II.)** E. RAUB & H. NANN. Nov.-Dec. 1935, pages 77-85. Detection of boric and citric acid either alone or when present together, and the destruction of citric acid in the bath by chlorates and HCl are described in detail. Ha (8d)

Modern Filtration Practice in Electroplating. PACE. *Monthly Review American Electroplaters' Society,* Vol. 22, Dec. 1935, pages 40-48. An important phase of producing heavy deposits, such as are demanded by the automobile industry, is clarity of the plating solution. Faster plating as now done in hot, agitated solutions requires the solution to be free from suspended particles, otherwise rough and pitted work will result. A common filter used in plating rooms has been the cartridge type, with bags supported by grooved boards, a centrifugal pump being used. Recently the plate-and-frame press, with a diaphragm pump, has come into winder use for plating solutions. It has the advantage that the cloth can be cleaned by reverse flow without taking the filter apart. The diaphragm pump has the added advantages of delivering constant volume under increased pressure, requiring no priming, and being free from packing glands and stuffing boxes. It operates at low speeds. In discussing the use of filter aids it is stated that a filter precoated with hyflo-supercel will remove particles as small as .1 micron in size (about 4/1,000,000"). GBH (8d)

Silverplated Organic Materials and Shapes (Versilberte organische Stoffe und Formlinge) F. OHL. *Oberflächentechnik,* Vol. 13, Feb. 18, 1936, pages 39-40. A new process for coating paper, leather and artificial resin surfaces with a bright Ag (or Au) film depends on cathodic atomization (dispersion); 5000 m. of Ag-plated paper strip can be made in 24 hrs. The greater the initial brightness of the surface of the material to be plated, the finer is the film. Very artistic effects can be obtained by contrasts in the surface. A cellulose foil plated by this method resembles a mirror in reflected light, but is transparent to transmitted light and appears more or less blue-violet according to the thickness of the film. To cover 1 $m.^2$ requires a fraction of a gram of Ag, Au or any other metal. Ha (8d)

Chromium Plating. O. Bauer, H. Arndt & W. Krause. Translated by E. W. Parker. Longmans-Green & Co., New York, 1935. Cloth, 6 x 9 inches, 266 pages. Price $9.50.

The German edition appeared in 1934 and was reviewed on page MA 144 of Vol. 5, Apr. 1934. It covered an exhaustive study of Cr plated parts from French and American automobiles, as well as many laboratory specimens. While plating practice has advanced considerably since the 1932 or '33 cars were produced, and many of the specimens serve chiefly as horrible examples, the principles brought out still hold. The translator has greatly increased the utility of the book by added comment and new references on many points. The bibliography covers 1920 to June 1935, with 582 references and an author index to them.

Hothersall's introductory chapter summarizes the findings of the authors and ties them up with the plating procedure. It seems that Cr plating is too narrow a term, for the value of a Cr coat is overwhelmingly dependent upon the thickness, adhesion, and freedom from porosity of the Ni undercoat, so that attention needs chiefly to be centered upon making a very good Ni plate. Flashing it with Cr for tarnish-resistance is the least difficult part of the process.

The book is very much worthwhile, but the price seems exorbitant.

H. W. Gillett (8d) -B-

Plating Technique (Galvanotechnik) H. Krause. 7th Edition. Max Jänecke Verlag, Leipzig, 1936. Paper, 5¾ x 8¼ inches, 275 pages. Price 5.40 RM.

Bath compositions and current densities are given for practically all metals commercially plated, the treatment being primarily that of a recipe book, though some discussion of whys and wherefores is given. The recipes, however, include much of the more recent developments which are sufficient to justify a new edition. The 6th Edition appeared 5 years ago. As in previous editions, the author gives credit in the text to various workers mentioned by name, but fails to give specific references.

The cook-book type of plater would find the volume decidedly useful. Those who keep up with other literature in the field and who seek broad viewpoint such as might be expected in a summary of this type, may be disappointed in it.

H. W. Gillett (8d) -B-

New Methods of Nickelplating (I Nuovi Metodi di Nickelatura Moderna). E. Staurenghi. *Industria Meccanica,* Vol. 13, Aug. 1935, pages 702-704. Present Ni-plating processes are reviewed, degreasing and cleaning methods described. The Ni content of the bath is about 40-50 g./l., current density 0.3-0.4 amp./dm.^{2} corresponding to a deposition of 0.324-0.432 g. Ni/hr., while for rapid plating methods 1-3 amp./dm.^{2} are employed. The bath is stirred and the pieces are moved to prevent streaks on the deposit; pH is 5.8-6.2. For rapid Ni plating the following bath is recommended: Ni sulphate 22.5 kg., ammonium sulphate 2.0 kg., Ni chloride 0.5 kg., Na perborate 0.5 kg. (all of high purity), water 100 l., temperature 35°-40° C., voltage 2.75-3.5. Ha (8d)

Bright Electrolytic Deposits (Glänzende Metallniederschläge) Max Schlötter. *Zeitschrift für Metallkunde,* Vol. 27, Oct. 1935, pages 236-237. Bright electrolytic deposits of metals have an extremely fine grain size, of the order of the wave length of light. The size of the anions of hydrolysis products of the salts in the electrolyte is of major importance in controlling the grain size since these anions may be deposited with the metal and thereby influence the manner of grain formation. The greater the volume of the anion, the greater the rate of grain growth of the metal and the smaller the number of nuclei formed, hence, the greater the grain size. Under certain conditions, the anions (halogens, oxides, hydroxides, sulphides, etc.) may be incorporated in the deposit in appreciable quantities and directly influence the physical properties of the metal. Discussions presented by: Masing, Schlötter, Rohn, Benedicks, Sterner-Rainer, and Raub.

FNR (8d)

Differences in the Structure of Electrodeposited Metallic Coatings Shown by X-Ray Diffraction. W. A. Wood. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1248-1253. Discussion page 1259. Structural modifications indicated by X-ray spectra and their influence on the physical properties of the coatings are discussed. The effect of coldworking as shown by the breadth of any given line, for instance (311) of Ni, is a rapid increase in the early stages up to a definite limiting value with no further change. The effects of lattice distortion and selective orientation are mentioned. With the present technique, X-ray spectra are sensitive to small changes of hardness, and it appears that large changes in hardness in a given structure produce gross diffusion of the spectrum. 7 references. PRK (8d)

Factors Affecting the Structure and Grain Size of Electrodeposited Cadmium. S. Wernick. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1237-1242. Discussion page 1259. In a bath containing a negligible amount of free CN and no alkali, the deposit formed from a solution containing 8 g./l. Cd, prepared by dissolving $CdCO_3$ in KCN, was grayish white and relatively coarse-grained. With increasing Cd content, deposits showed a progressive refinement and that obtained from a bath containing 30 to 40 g./l. Cd was finely crystalline. With about 50% free CN, the deposit showed improvement in color, approaching whiteness. The macrostructure of the deposit containing 100-150% free CN showed it to be very finely grained. It is desirable to limit the free CN content to 100%. The presence of NaOH in excess of .85% aided materially in the formation of a fine grain deposit and was important in maintaining color and uniformity. 1.2-1.5% produced particularly excellent deposits. In a bath containing 30 g./l. Cd, 100% free CN and 1.5% NaOH, the deposit was white and fine-grained but became progressively grayer and more crystalline as the current density was increased above the initial value 10 amp./ft.^{2} and at 30 amps./ft.^{2} the deposit was burned. Increase of temperature of the solution above 30-35° C. caused marked deterioration of the physical properties. In solutions made from $CdSO_4$ it was found necessary to use buffers. A solution containing molar $CdSO_4$, 30 g./l. HBO_3 and N/10 NaCl, with pH range 5.5 to 6.6 produced a small grained crystalline deposit which was not comparable in refinement with that obtained from CN electrolyte. The deposit became burnishable when the current density exceeded 35 amps./ft.^{2} Treeing occurred when current density exceeded 45 amps./ft.^{2} In studying the effect of increasing temperature from 22°-80° C. a reduction in crystal size was noted up to 50° C. with simultaneous darkening of the deposit. With increasing temperature the deposit became whiter but more crystalline. Study of colloidal additions revealed that the whitest and most mat type of deposit was obtained from electrolyte containing .08-.16% gelatin. 16 references.

PRK (8d)

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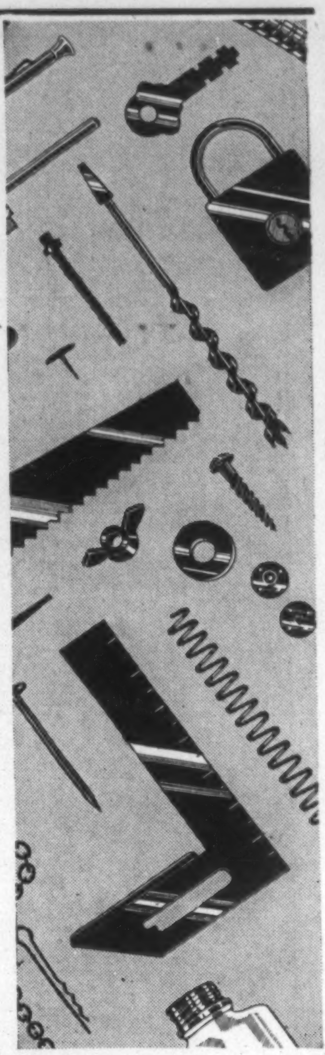

8e. Metallic Coatings other than Electroplating

Influence of Tinning Procedure on Pinholes in Tin Plate (Einfluss der Arbeitsbedingungen beim Verzinnen auf die Porigkeit von Weissblechen) F. Peter & G. Le Gal. *Archiv für das Eisenhüttenwesen,* Vol. 9, Dec. 1935, pages 285-291. Pinholes in tinplate depend on the surface cleanness of the prepared black sheet, the thickness of the coating, the pickling procedure, the cleanness of the flux, etc. H_2 absorbed in pickling and evolved in tinning does not appear to play an important part. Despite all precautions pinholes cannot well be eliminated in commercial tinplate. With a heavy Sn coating of 100 g./m.^{2} tinplate free from pinholes can be obtained, but only when the utmost precautions are taken.

SE (8e)

Improvement of the Quality of Sprayed Metallic Coatings by the Use of Non-metallic Intermediaries and Supports. H. Reininger. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1268-1276. Discussion page 1286. With hard brass sprayed with Ni, it was shown that soft copal varnish and bakelite varnish will penetrate into the porous structure of the sprayed metal coating and, after drying, form intermediary layers between the metal grains. The strength of the coating and its adhesion to the basis metal are increased. Metal coated in this way can be deformed plastically to a higher degree without separation of the coating from the base than if the coating has not been varnished. It is possible to grind the varnished coating practically down to the base without coating splitting off. The varnished coatings do not form galvanic elements with the basis metal and electrochemical corrosion is greatly retarded as a result.

PRK (8e)

Aluminum Coating (Aluminiumplattierung) H. G. Heine. *Korrosion und Metallschutz,* Vol. 11, Nov. 1935, pages 250-251; *Aluminium and the Non-ferrous Review,* Vol. 1, Dec. 1935, pages 85-86. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 136R/4. Ha + JCC (8e)

Influence of Surface Cuprous Oxide Inclusions on the Porosity of Hot-tinned Coatings on Copper. W. D. Jones. *Journal Institute of Metals,* Vol. 58, Feb. 1936, pages 109-116 (Advance Copy No. 727). A study of Sn coatings on Cu shows that inclusions of Cu_2O are responsible for most of the porosity. Amalgamation with Hg salts, rather than with metallic Hg, was found to be a good method for estimating probable porosity. Various methods of reducing porosity are discussed. These include cathodic treatment in caustic soda and treatment with hypophosphorous acid. The former was found to be the better. O-free Cu is recommended if non-porous Sn coatings are to be obtained. JLG (8e)

Spraying Liquid Metal to Decrease Corrosion. Robert E. Kunkler. *Metallizer,* Vol. 4, Nov. 1935, pages 6-8, 13. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 136R/8. BWG (8e)

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Factors Influencing the Formation and Structure of Hot-dipped Tin Coatings. Edward J. Daniels. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1277-1285. **Hot-dipped Tin Coatings.** *Sheet Metal Industries,* Vol. 9, July 1935, pages 425-428; *Mechanical World & Engineering Record,* Vol. 47, June 21, 1935, page 611. The attraction between the liquid and solid metals as a prime cause of wetting is discussed. Affinity between the basis metal and the molten coating metal results in the formation of an intermetallic compound or solid solution favoring adhesion. Additions to the molten metal sometimes alter the structure of the coating. The influence of the melting point, especially of the flux, upon the success of hot-dipping operations is discussed. The use of P in molten Sn and of H as fluxes are mentioned. The cause of the formation of ripples and spangles is discussed. 35 references. PRK + AWM + WH (8e)

Coloring of Metals. H. MacFadyen. *Monthly Review American Electroplaters' Society,* Vol. 22, Nov. 1935, pages 13-21. Describes some methods used in finishing metal parts of electrical wiring devices. Ground terminals, to be identified by Sn coating, are immersed for 20 minutes in a boiling solution containing Sn chloride 2, NaOH 2.5, and NaCN 1 oz./gal. Small studs to be given a Cu finish are first tumbled in a steel barrel with KOH to clean them, rinsed thoroughly, the water replaced with a gallon of solution containing 2 ozs. of $CuSO_4$ and 1 oz. of H_2SO_4, and the tumbling continued for ½ hr. after which they are rinsed. Galvanized Fe parts to be lacquer enameled are first treated with a 10% solution of acetic acid, rinsed in cold and then hot water and dried. This treatment results in good adhesion of the enamel to the galvanized surface. Sheet paper, fiber, and bakelite parts are waterproofed by tumbling about 40 lbs. of the work in a barrel for 20 minutes with ¼ pint Valspar varnish plus ¼ pint thinner. The pieces will not stick together if excess varnish is avoided. Steel parts covered with drawing oils are cleaned by tumbling in sawdust. It was found that potash cleaning was not necessary for this work and that it could be placed directly in the plating barrel. A black finish on steel or Fe parts is obtained by rotating 100 lbs. of the work together with ½ pint of raw linseed oil in a gas-fired retort of 650° F., for 1½ hrs. Upon removal, the work is dipped in raw linseed oil and dried in a centrifugal dryer. GBH (8e)

Metal Spraying in the Welding Shop. H. B. Rice. *Welding Engineer,* Vol. 21, Jan. 1936, pages 34-42. Metal spraying as a means of repairing and building up worn pieces is described and illustrated. In some cases spraying is preferred to welding as less metal is needed and a continuity of galvanized surfaces can be obtained by spraying Zn on welded areas. The C content in the welding or spraying rod is reduced more in spraying than in welding, 20-40% C is lost in the spraying process. Many examples in railroad and engine building practice are described. Ha (8e)

The Development and Control of Spangles on Galvanized Iron. Part 3. W. G. Imhoff. *Metal Cleaning & Finishing,* Vol. 7, Apr. 1935, pages 173-177. Small granular spangles are caused by the steel becoming oxidized. The fuel-air mixture for the soaking pit firing should be non-oxidizing. Overheating should be avoided. GBH (8e)

8f. Non-Metallic Coatings

Oxidation Films on Aluminum and Its Alloys; Their Production and Properties (Pellicules d'oxydation sur l'aluminium et ses alliages; leur production et leur propriétés) A. G. C. Gwyer & N. D. Pullen. *Revue de Métallurgie,* Vol. 32, Dec. 1935, pages 658-667. Films produced by anodic oxidation of Al have either high or low resistance to current. The former are used principally in electric apparatus. The latter are employed for corrosion protection and for colored Al ware. The color, hardness, electrical resistance, composition, etc. of the films vary widely with the nature of electrolyte, its concentration, temperature, current used, etc. A series of tests is proposed for the determination of the desired properties of these films. Aluminum alloys with 3, 6, 9, and 12% Cu, 13% Zn and 10-12% Si were studied metallographically after anodic treatment in chromic, sulphuric and oxalic acid solutions respectively. In chromic acid, Cu content of 9% prevents the formation of a uniform film. The metal is oxidized along Cu inclusions. The same effect occurs in H_2SO_4 solution. In oxalic acid 12% Cu does not interfere with a continuous film formation. In none of these solutions does 13% Zn disrupt the continuity of the film, nor does 10-12% Si. Operating data and 30 photomicrographs are given. JDG (8f)

Progress Made in Surface Treatment and Finishing of Aluminum. R. T. Griebling. *Steel,* Vol. 98, Mar. 23, 1936, page 50. Describes briefly painting of Al and the Alumilite and Alzak finishing processes for Al. MS (8f)

Processing of Enameled Wire. *Industrial Heating,* Vol. 3, Mar. 1936, pages 185-186. Heat treatment of wire to be enameled, and process itself and equipment for it are described. Ha (8f)

Paint Films of Controlled Thickness. H. G. Arlt. *Bell Laboratories Record,* Vol. 14, Mar. 1936, pages 216-217. An automatic spraying machine was developed for producing paint films of absolute uniformity so that reliable measurements of physical properties, corrosion resistance, etc. can be made. A uniformity of 1/10000" over the entire area (except the marginal zones) can be obtained. Ha (8f)

Effect of Mill Practice and Mill Additions on the Opacity of Enamels. G. L. Bryant & F. R. Porter. *Journal American Ceramic Society,* Vol. 19, Feb. 1936, pages 55-59. Tests showed that fine grinding increases opacity but the effectiveness is variable with different enamels so that with some the cost of fine grinding offsets added benefits. SnO up to 6% increases opacity in frit blends studied and type of clay added to mill batch has an important effect on opacity of the enamels. Effect on opacity depends on whether SnO is added at end or beginning of mill batch. Addition of feldspar to some of the enamels increases opacity either by preventing solution of SnO in enamel glass or by undissolved feldspar. Some SnO substitutes are as effective as Sn oxide with certain frit compositions. WB (8f)

Aluminium Paint as a Primer. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, page 21. Brief account of tests by Forest Products Laboratory of the U. S. Department of Agriculture on aluminium paint as a primer on woods in house painting. JCC (8f)

Protective Paint Coats on Aluminum (Schutzanstriche auf Aluminium) *Oberflächentechnik,* Vol. 13, Feb. 4, 1936, pages 29-31. Although the natural film on Al is often quite sufficient for protecting Al parts against atmospheric and other attacks, a more protective coat is sometimes required. If a coat of paint is to be applied the natural oxide film must first be removed, by pickling in NaOH solution of 10-25%, sandblasting, treating with emery paper, or Cu plating. Such coats must not contain alkaline constituents or acid residues such as Na silicate, Ca, basic pigments, Fe oxide red, as they react with the Al; also red Pb cannot be recommended. Bitumen and chlor-caoutchouc coats are not very reliable. Ti white in oil, polymerizations of organic, non-saturated fatty acids both mixed with other lacs or in nitrocellulose are very effective. Lately, phenol resins have been applied with good success. Conditions, both favorable and unfavorable to the application of these materials as protective coating on Al are discussed. Ha (8f)

Protective Materials in Use for Outdoor Structural Work. *Steel,* Vol. 98, Feb. 24, 1936, pages 42-43. Metal protective paints should contain no pigments which form H_2O-soluble compounds or promote chemical action within dried paint film. For maximum durability, there should be about 30% by volume of opaque pigment in the dried paint film of the priming coat. Good primers are basic $PbCrO_4$, Pb_3O_4, and basic $PbSO_4$. Chemical surface treatment prior to painting is recommended. MS (8f)

Eliminating the Blistering of Enamels on Cast Iron. H. D. McLaren. *Steel,* Vol. 97, Dec. 30, 1935, pages 25, 40. From *Enamelist,* Vol. 12, July 1935, pages 6-7, 46, 60. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 500R/8. MS (8f)

Painting on Copper (La Peinture sur Cuivre). J. Meyral. *Cuivre et Laiton,* Vol. 8, Nov. 15, 1935, pages 471-474. Cu is an excellent base for oil paints, preferable to Fe and Zn. Coats of paint are more durable on Cu in the open air than on other metals. Procedures are described. Ha (8f)

Aluminium Powder as a Metal Finish. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 19-20. Vehicles for aluminium paints and their uses are discussed. Mica is an objectionable adulterant and is detected as a residue remaining after dissolving sample in HCl. JCC (8f)

Cracking of Enameled-Iron Edges (Ueber das Abspringen der Emailränder). Richard Aldinger. *Keramische Rundschau,* Vol. 43, Jan. 17, 1935, pages 25-28. Discusses theoretically the causes of flaking and cracking of enameled metal ware. Stress conditions are most important, and are affected by differential expansion of Fe and the enamel, and by the position of the enamel on the interface curvature. Defects in the enamel, production faults, and flaws in the underlying metal are systematically classified and their effects on the cohesion and adhesion of the enamel discussed. FPP (8f)

9. TESTING

9a. Inspection & Defects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

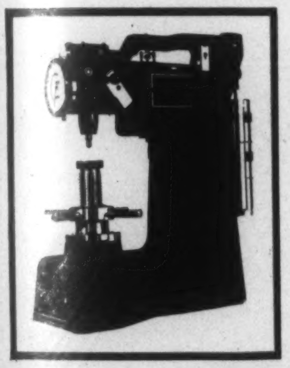
Electrical Engineering in Radiology. L. G. H. SARSFIELD. Instruments Publishing Company, Pittsburgh, 1936. Cloth, 5½ x 8¾ inches, 276 pages. Price $6.00 postpaid.

The volume of business involved in the manufacture of medical and industrial X-ray apparatus in late years is considerable, and has justified the maintenance of active research and development laboratories by a number of concerns. These have put on the market an extensive and diversified array of X-ray tubes, rectifiers, transformers, voltage regulators, condensers, cables, control gear, etc. While books on X-ray radiology, radiography and diffraction have explained the fundamental principles of this art, they have had space for no extensive discussion of the requisite equipment. Thus there is a definite place in the world for a book dealing, as this one does, with the design, testing, operation and maintenance of these devices. The author is well equipped to write authoritatively, as he has had a number of years' experience in the radiological research laboratory at Woolwich. He discusses a number of tests and experiments he has made and includes some detailed designs of transformers that he has built. He is familiar with apparatus manufactured on the continent and in America and has not limited the book to British apparatus.

Most of the book is presented in a common-sense fashion easily understood by anyone, only a relatively small portion of the book requiring familiarity with the more technical concepts in electrical engineering.

Research laboratories will find particularly useful the full discussion of voltage-multiplying circuits and constant-potential circuits, the data on designs of high-voltage transformers, filament transformers and bushings for high-voltage insulation, and the discussions of operating characteristics. There are numerous references to the literature for more detailed accounts. C. S. Barrett (9a) -B-

Inspection, Testing and Gages at the Ford River Rouge Plant. *Mill & Factory,* Vol. 18, Jan. 1936, pages 172-182. The effect of Ford's application of precision methods on the constantly closer tolerances in evidence throughout the automobile industry is discussed. Inspection devices that make possible 3030 parts (in one car) manufactured to tolerances less than .005" include 93 visual gages, a master gage system of Johansson blocks, special automatic camshaft sizing machines, fatigue, shock, bend, torsion testers, distributor timing gage, recording gasoline flowmeter, etc. Rooms are air-conditioned to increase precision. FPP (9a)



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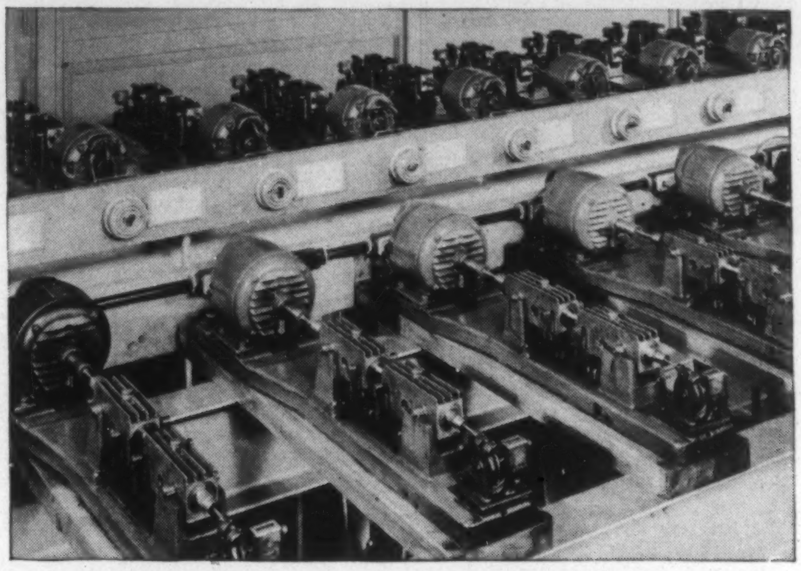

The Phenomena of Fatigue

Many perplexing problems of the failure of machine parts to withstand service conditions are now being solved by the "repeated stress" or "fatigue test."

Research has shown that the fatigue test discloses factors shortening the life of materials in service which cannot be revealed by tension, hardness, ductility, impact, or other routine tests. For failures in service seldom occur under the application of a single stress which approaches the ultimate strength of the material.

Such failures usually occur after the repeated application of stress below the ultimate strength of the material. Such failures are progressive, due to the development, growing and spreading of fine cracks—the final rupture occurring with no warning and with practically no deformation of the metal.

Problems which involve the comparison of effects of various factors upon the value of metals as structural materials, always therefore, should consider the effect on the result of the "repeated stress" or "fatigue test." Such factors as chemical composition, mechanical treatment, heat treatment, corrosion, methods of joining, sudden changes in section, affect the metal more severely under repeated stress than under a single application of a gradually increasing stress.

To closely approach service conditions in a fatigue test, accommodating actual full-size machine shafts and other parts, and reproducing years of service in a few days, the R. R. Moore Fatigue Testing Machine was developed. It soon became the recognized standard. Today hundreds are in use in practical investigation in many well-known manufacturing plants and research laboratories.

Bulletin No. 96, describing this machine, will be sent on request.

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Results of Technical X-ray Science. Vol. V. Commercial Applications of the Radiographic Method (Ergebnisse der technischen Röntgenkunde. Band V. Anwendungen der Durchstrahlungsverfahren in der Technik) J. Eggert & E. Schiebold. Akademische Verlagsgesellschaft, Leipzig, 1935. Cloth, 6¼ x 9¼ inches, 118 pages. Price 15 RM.

This latest volume of the series is strictly limited in scope, dealing only with radiography, and is smaller than the previous volumes. It is not intended as a handbook or a textbook on radiography (the fundamentals have already been treated in numerous books including earlier volumes of this same series); it is, rather, a collection of short papers by the users of the method, telling what it has been able to do for them in their special fields. For example, there is a chapter on aircraft applications which discusses the testing of wooden parts, both with X-rays and with a 2000 watt light (the latter penetrates thicknesses up to 2½ mm.); the radiography of various kinds of metal parts, including castings, welded joints, and locating cracks by radiography and by other non-destructive methods; the effect of defects on the strength of parts; and the detection of faulty assembly of parts. Each paper includes a short note on the apparatus most suitable and on whether or not gamma-rays are satisfactory for that particular type of work. That Germany is making wide use of radiographic testing is shown by the list of fields in which successful application is reported: aircraft; marine equipment, including ships' boilers, Diesel motor parts, torpedo equipment, high pressure tanks and tubing, and propellers; railroad equipment, such as locomotive boilers, high pressure vessels, welded beams, parts of railway turntables, reinforced concrete structures; welded bridges; pressure vessels for the petroleum industry; and the detection of internal corrosion and breakage in steel cables. Several of the authors of these chapters state that they have been using X-rays for several years and have come to consider them indispensable.

Some recent developments in technique are described and their advantages discussed: the use of filters and wedges made of tin and placed between specimen and film to remove scattered rays and to equalize exposures; the development of a method for exposing greater lengths of welds in a single exposure by placing a high voltage tube at a distance of several meters from the work; the use of flexible high voltage cables, 30 to 60 feet long, connecting the transformers to portable tubes; and new designs in tubes, tube mountings, and film holders. Ten different authors have contributed papers; there are in all 87 references, of which 81 are to German literature. The papers contain numerous cross-references and are well illustrated with photographs and radiographs; exposure data are given for all radiographs that are printed. C. S. Barrett (9a) -B-

Autogenous Welding (Soudure autogène) R. Schmidt. *Usine*, Vol. 45, Mar. 19, 1936, page 29. The radiography of welds and the application of X-rays for their examination are explained. A radiograph of a piece of 20 mm. thickness can be obtained with 100,000 v., of 80 mm. with 200,000 v., and of 140 mm. with 400,000 v.; the time of exposure is less than 1 min. The limitation of the method in recognizing defects is discussed. Ha (9a)

Strength of Scattered radiation in Radiography (Stärke der Streustrahlung bei Röntgendurchstrahlung) O. Vaupel. *Archiv für das Eisenhüttenwesen*, Vol. 9, Oct. 1935, pages 213-214. The aim was to protect operators of X-ray machines from stray radiation. The effects of distance of the operator from the radiated object, of the angle of the scattered beam with the primary beam, size of the radiated surface, distance of X-ray tube from the surface, and X-ray voltage, were studied. A formula is given by which the strength of X-ray dosage at different locations can be calculated. SE (9a)

■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

Calculation of the Elongation in a Tensile Test for Various Gage Lengths (Umrechnung der im Zugversuch ermittelten Bruchdehnung auf andere Probenmesslängen) W. Kuntze, F. Uebel & F. Gentner. *Archiv für das Eisenhüttenwesen*, Vol. 9, April 1936, pages 509-523. A comprehensive discussion of this problem. Curves are given whereby the elongation for any gage length can be calculated, when the elongation for a certain gage length is obtained. SE (9b)

On the Modulus of Elasticity of Wire Ropes. B. M. Suslov. *Wire & Wire Products*, Vol. 11, Apr. 1936, pages 176-182. Present practice in Russia of manufacture of wire rope and cables is shown and methods of determining structural and elastic elongation explained. The modulus of elasticity depends on number of strands, number and diam. of wires in a strand, material of center (hemp or metallic), type of stranding, physical nature of a rope (new or old), wire material, degree of wear, and degree of prestressing in the manufacturing process or in service. The tests permit the conclusion that in order to have high modulus wire ropes, it is necessary to use multiple stressing of new ropes, or to use old used ropes for this purpose. This confirms previous results by Sunderland (*Engineering News Record*, Mar. 7, 1930). Ha (9b)

Effect of the Springing of a Tensile Machine on the Stress-Strain Curve (Einfluss der Federung der Zerreissmachine auf das Spannungs-Dehnungs-Schaubild) W. Späth. *Archiv für das Eisenhüttenwesen*, Vol. 9, Dec. 1935, pages 277-283. A tensile machine consists of a combination of springs and weights. In static loading the stress-strain curve depends on the self-springing of the machine. The harder the springing the more sensitively it records the fall in stress on plastic yielding. With soft springing the stress may remain constant during plastic flow. It is suggested that the "lower yield point" results from the springing characteristics of the machine rather than from the characteristics of the material. This is disputed in the discussion. SE (9b)

Research on Yield Limits and the Tensile Strength of Mild Steel and Other Metals. G. Welter. *Metallurgia*, Vol. 13, Jan. 1936, pages 89-92. The lower yield point and the drop in stress after the maximum stress has been reached in ordinary tensile testing have no significance because they depend on the machine and not the test piece. Stress-strain curves made with dead loading are given to prove that as a specimen is gradually stretched the unit stress never decreases. It is suggested that tensile machines should be redesigned so that in spite of rapid elongation of a specimen the load will not decrease. JLG (9b)

Present Position of the Cast-Iron-Test-Bars. *Foundry Trade Journal*, Vol. 53, Aug. 29, 1935, pages 146-147. Discussion of paper on "Relationship in Cast Iron Test Results" by Harbach (see *Foundry Trade Journal*, Vol. 53, July 25, 1935, pages 61-63; Aug. 1, 1935, pages 85-87; abstracted in *Metals & Alloys*, Vol. 7, Mar. 1936, page MA 139L/2). J. G. Pearce pointed out that it was shown in his laboratory some years ago that, other things being equal, a round bar was always stronger than a square bar. That difference had nothing to do with casting conditions, because it remained true even if the square bar was made from one which was originally cast round, and if the round bar was made from one originally cast square. The difference was due, probably, to the manner in which the stress distributed itself across the section of the bar. The result was that the 2" by 1" bar broken at 36" centers broke at a load almost identical with the 1.655" bar at 24" centers if the latter were made a little bit smaller. If it were made 1.6" instead of 1.655" the loads should be about the same. The difference was, roughly, about 10%. This suggested that a very convenient range might be obtained for bars for testing purposes if, say, there were diameters of 0.8", 1.2", 1.6" and 2", each tested at a span equal to 15 dias., respectively, 12", 18", 24" and 30". Those 4 bars have diameters with ratios of 1, 1½, 2, 2½, and the ratios of the areas were roughly, 1, 2, 4 and 6. John Shaw is of the opinion, based on many experiments, that the bar should be as short as would yield a reasonable deflection. This was lately confirmed by J. T. Mackenzie, who found little difference in the deflection of the 2" bar when tested either at 18" or 24" centers. AIK (9b)

The Elements of the Theory of Strain Energy. R. J. Cornish. *Structural Engineer*, Vol. 14, Mar. 1936, pages 160-161. The main principles underlying the strain energy theorem are summarized briefly. Assuming elastic materials the author cites application of the theorem to direct stress, bending, shear, torsion and total strain energy problems. FPP (9b)

Heat Evolved During the Tension Testing of Steel (Untersuchungen über die Wärmetönung beim Zugversuch mit Stahlproben) H. Esser, H. Cornelius & W. Banck. *Archiv für das Eisenhüttenwesen*, Vol. 9, Apr. 1936, pages 529-533. A very accurate flow calorimeter was devised for determining the heat evolved during the tension testing of steel. The latent heat during elastic deformation increased with increasing C content. Raising the Cr content decreased the latent heat in ferritic steel more than in austenitic. Ni raised the latent heat more in austenitic steels. The state of heat treatment had little effect. An increase in latent heat occurred above the yield strength, soon reached a maximum, and decreased again as necking down began. SE (9b)

Rockwell and Vickers Apparatus for the Determination of Hardness (Gli Apparecchi Rockwell e Vickers per la Determinazione della Durezza: (Rc); (Vp)) A. Golassini. *Industria Meccanica*, Vol. 19, Mar. 1936, pages 117-127; Apr. 1936, pages 187-194. The principles of hardness measurement by the methods of Rockwell and Vickers are explained, the manner of their application and which to select, and their numerical relations are described at length. Examples illustrating advantages and modes of application are given. Ha (9b)

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9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Fatigue of Metals. H. J. GOUGH. *Proceedings Staffordshire Iron & Steel Institute,* Vol. 50, Session 1934-35, pages 74-97. 19 references. A discussion of some of the more recent developments of interest. I. The new machines. (a) Fatigue machine of Dowling, Dixon and Hogan, for testing wire, (b) fatigue machine for testing wire by Haigh and Robertson, (c) high frequency machine of Krouse, (d) combined stress fatigue stress testing machines, (e) N.P.L. machine for testing plates, also riveted and welded joints under boiler conditions. II. Corrosion—Fatigue. A fairly extensive program of work on the corrosion-fatigue characteristics of commercial materials is in progress at the National Physical Laboratory. III. Fatigue testing of full-sized components. (a) Tests on drill pipe and pipe joints, (b) some current Swiss experiments, (c) tests on metal air-screws, (d) tests on lifting gear, (e) tests on riveted and welded drums. IV. Fatigue tests at low temperatures. V. Suggested accelerated method for determining the fatigue limit. VI. Fatigue as a fundamental problem. VII. International Cooperation directed towards the study of materials of construction. GTM (9c)

Some Further Experiments on Atmospheric Action in Fatigue. H. J. GOUGH & D. G. SOPWITH. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 55-89. See *Metals & Alloys,* Vol. 6, Feb. 1935, page MA 67L/1. (9c)

Corrosion-fatigue Properties of Duralumin With and Without Protective Coatings. I. J. GERARD & H. SUTTON. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 29-53. Includes discussion. See *Metals & Alloys,* Vol. 6, Feb. 1935, page MA 65L/3. (9c)

Fractures Without Deformation in Boiler Parts (Verformungslose Brüche an Kesselteilen) W. RUTTMANN. *Zeitschrift Verein deutscher Ingenieure,* Vol. 79, Dec. 28, 1935, pages 1561-1564. Fractures without deformation are in general due to pure endurance fractures without corrosion, or corrosion fatigue fractures, and intercrystalline fractures, i.e. fractures in the grain boundaries. Recent investigations showed, however, that not every fracture without deformation is due to fatigue. For fractures in boilers, in particular, it can be stated that fractures in flanges are usually due to vibration or corrosion-vibration fatigue, but that cracks around rivet holes can by no means be ascribed to fatigue, but must rather be ascribed to some, as yet unexplained static stress, possibly to chemical action as indicated by the investigations of Straub and by Schroeder and Berk. 18 references. Ha (9c)

The Strength of Metals Under Combined Alternating Stresses. H. J. GOUGH & H. V. POLLARD. *Mechanical World & Engineering Record,* Vol. 9, Nov. 22, 1935, pages 501-502; Nov. 29, 1935, pages 527-528, 536; *Engineering,* Vol. 140, Nov. 8, 1935, pages 506-508, 511-513; Nov. 15, 1935, pages 541-542; Nov. 22, 1935, pages 565-567. Paper before the Institution of Mechanical Engineers. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 25R/2. WH + LFM (9c)

The Cast Crankshaft (Die Gusskurbelwelle) A. THUM & K. BANDOW. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Jan. 4, 1936, pages 23-27. Fatigue bending and torsion tests with crankshafts of (forged) steel, malleable casting and pearlite casting have shown that for all constructions, the fatigue bending strength is lower than the fatigue torsion strength. (Note by H.F.M. This is probably due to the fact that under repeated or reversed torsion cast iron fails by diagonal tension rather than by shear. The diagonal tensile stress in torsion is equal to the shearing stress and cast iron is usually stronger in shear than in tension). It is possible to increase the fatigue strength of cast crankshafts considerably by correctly shaping them so that they become almost equal to forged steel. The advantage of a cast crankshaft is that the freedom in giving it a proper shape is much greater than for forging, weights can be reduced and cost, especially in quantity production, lowered. 15 references. Ha (9c)

9e. Spectrography

Spectrographic Determination of Arsenic, Phosphorus, and Sulphur in Metals, Especially in Platinum (Spektralanalytische Bestimmung von Arsen, Phosphor und Schwefel in Metallen, besonders in Platin) W. ROLLWAGEN & K. RUTHARDT. *Metallwirtschaft,* Vol. 15, Feb. 21, 1936, pages 187-189. The methods are developed for the semi-quantitative analysis of P and As in Pt, as little as 0.005% being detectable by means of a flashing arc. About 0.05% S can be shown by a condensed discharge in a Geissler tube. GD (9e)

Quantitative Spectral Analysis of Aluminum Alloys (Quantitative chemische Spektralanalyse von Aluminiumlegierungen) G. SCHEIBE & A. SCHÖNTAG. *Metallwirtschaft,* Vol. 15, Feb. 7, 1936, pages 139-141. The visual analysis of Al alloys with the spectroscope is made difficult by the scarcity of Al lines. However, with a standardized electrode arrangement and constant current it is possible to use lines from the atmosphere when calibrated against known samples. Si, Cu, and Na were determined in this way with an accuracy satisfactory for control work. By using one Cu electrode Mg was determined. Mg, Si, Mn were determined photographically by comparison with Al lines. Attempts to determine Fe were not successful. For all spectroscopic work with Al alloys it is important to have specially prepared small chill castings to avoid segregation. The electrodes must not be overheated or they will react too much with the air. The accuracy of photometric analysis is twice that of visual, but it requires hours as compared to minutes for the visual. GD (9e)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

A Redetermination of the Parameter of Hauerite, MnS_2. FRANKLIN OFFNER. *Zeitschrift für Kristallographie,* Vol. 89, Oct. 1934, pages 182-184. (In English.) By means of Laue photographs a parameter of 0.4012 ± .0004 A. U. was found. The S—S distance is 2.086 ± .008 A. U. yielding a bond radius for S of 1.043 ± .004 A. U. which is in good agreement with the value determined by Pauling & Huggins. The anomalous radius of 1.55 A. U. for Mn is confirmed. EF (10)

Structural Determinations of Complex Sulphides (Ergebnisse der Strukturbestimmung komplexer Sulfide) WILHELM HOFFMANN. *Zeitschrift für Kristallographie,* Vol. 92, Dec. 1935, pages 161-185. The arrangement of the S and metal atoms in the sulphides and S salts of As, Sb and Bi are discussed. Further information on the previously described structures of the $CuSbS_2$ and SbS_3 structural types is given. EF (10)

The NiS and NiSe Structure and Their Variations (Strutture ed alterazioni di struttura di NiS e di NiSe) G. R. LEVI & A. BARONI. *Zeitschrift für Kristallographie,* Vol. 92, Dec. 1935, pages 210-215. In Italian. γ NiS is identical with Millerite: rhombohedral, a = 9.61 A.U., c = 3.15 A.U.; c/a = 0.32 β NiS is identical with the known synthetic NiS preparations; *i.e.,* hexagonal with a = 3.42 A.U., c = 5.30 A.U., c/a = 1.55 α NiS is amorphous and undergoes some changes in air but does not become crystalline. The transformation γ NiS → β NiS was studied by electron interferences. The structures of NiSe are completely analogous to the corresponding NiS structures. EF (10)

Precise Determination of the Lattice Constant of Silicon (Präzisionsmessung der Gitterkonstanten von Silizium) M. C. NEUBURGER. *Zeitschrift für Kristallographie,* Vol. 92, Dec. 1935, pages 313-314. Si of 99.84% purity (bal. 0.1% N, 0.027% Fe, 0.014% Ca, 0.008% Al, 0.004% C, 0.002% O and trace of H) was investigated. The lattice parameter is a = 5.4173 ± 0.0005 A.U. at 20° C. (On the same material, the determination of JETTE & FOOTE, *Journal of Chemical Physics,* Vol. 3, 1935, pages 605-616, gave a = 5.41982 ± 0.00034 A.U. at 25° C.—Abstractor). Using an atomic weight of 28.06, the density of Si was calculated to be 2.327, atomic radius = 1.173 A.U. EF (10)

Lattice Constant and Allotropy of Beryllium (Gitterkonstante und Allotropie von Beryllium) M. C. NEUBURGER. *Zeitschrift für Kristallographie,* Vol. 92, Dec. 1935, pages 474-475. Contrary to previous determinations by Owen, Pickup, & Roberts *(Zeitschrift für Kristallographie,* Vol. 91, 1935, pages 70-76) who found a = 2.2812 A.U., c = 3.5781 A.U. and c/a = 1.5685, the redetermination of Neuburger yielded a = 2.2680 ± 0.0003 A.U., C = 3.5942 ± 0.0004 A.U., c/a = 1.5847 at 20° C. using a metal with only spectroscopic traces of Fe, Ba and C. The considerable deviation between these determinations is ascribed to the impurities present in the Be (99.75%) utilized by the British investigators and to the allotropy of Be. The $\alpha \rightarrow \beta$ transformation occurs between 500° and 600° C. and is considerably delayed on cooling. The material used by Owen and coworkers was annealed previous to X-raying. EF (10)

Precision Determination of the Lattice Constant of Highly Pure Columbium (Präzisionsmessung der Gitterkonstanten von sehr reinem Niob) M. C. NEUBURGER. *Zeitschrift für Kristallographie,* Vol. 93, Jan. 1936, pages 158-159. Cb prepared by Burgess & Basart (See *Zeitschrift für anorganische & allgemeine Chemie,* Vol. 216, 1934, pages 223-227) yielded a = 3.2941 ± 0.0003 A.U. at 20° C. The density derived therefrom is 8.569 and the atomic radius is 1.4264 A.U. EF (10)

Precision Determination of the Lattice Constant of very Pure Tantalum (Präzisionsmessung der Gitterkonstanten von sehr reinem Tantal) M. C. NEUBURGER. *Zeitschrift für Kristallographie,* Vol. 93, Mar. 1936, pages 312-313. Previous determinations are reviewed. Ta prepared by Burgers & Basart (See *Zeitschrift für anorganische & allgemeine Chemie,* Vol. 216, 1934, pages 223-227) gave a = 3.2959 ± 0.0003 A.U. at 20° C. Density = 16.655. EF (10)

Lattice Constants for 1936 (Gitterkonstanten für das Jahr 1936) M. C. NEUBURGER. *Zeitschrift für Kristallographie,* Vol. 93, Jan. 1936, pages 1-36. Comprehensive survey. Lattice constants for 1936 including data on atomic weights, density, number of atoms per unit cell, lattice parameter, shortest interatomic distance, atomic radius, atomic space, density of packing, volume of atom, transformation temperature are tabulated. Periodic system. Radii according to Goldschmidt. A special table presents detailed information on the purities of elements investigated, which represents an interesting account of the advance in the preparation of highly pure elements. 140 references. EF (10)

Question of Picture Size in Photomicrographic Work on the Metal Microscope (Zur Frage des Aufnahmeformates bei mikrophotographischen Arbeiten am Metallmikroskop) ERNST ROSSOW. *Zeitschrift für Metallkunde,* Vol. 27, Nov. 1935, pages 263-264. The 35 mm. micrographic camera is compared with the common bench-type metal microscope: (1) enlargements of 35-mm. negatives show resolution nearly equal to that on plates taken directly with the larger microscope provided that a fine-grained film is used; (2) cost of operating the 35-mm. camera is low both in actual cost of materials and in cost of labor; and (3) the speed of operation of the 35-mm. camera is much greater. FNR (10)

Roentgenographic and Electric Investigation of Pd-Ag-H alloys (Röntgenographische und elektrische Untersuchung der Pd-Ag-H-Legierungen). G. ROSENHALL. *Annalen der Physik,* Series 5, Vol. 24, Oct. 1935, pages 297-325. The Pd-Ag-H diagram was established. An unexpected change of resistance was found which lasts a fairly long time before equilibrium is attained. Pd-Ag alloys have a particular aptitude to absorb H; it could, however, not be determined definitely whether the H atoms are embedded in the interstices of the Pd-Ag lattice or if metal and silver-like Pd-H atoms are distributed on the face-centered lattice points. The electric measurements seem to support the latter hypothesis. Ha (10)

Kinetics and Mechanism of the Allotropic Transformation in the Palladium-copper System (Kinetik und Mechanismus der allotropen Umwandlung im System Palladium-Kupfer) L. Graf. *Physikalische Zeitschrift*, Vol. 36, July 15, 1935, pages 489-498. The course of the allotropic transformation in Pd–Cu system has been studied by X-rays and microscopically on single crystals containing 40-50 at. % Pd. A 2-phase transformation has been noticed whereby the β crystals decompose into a polycrystalline structure of a certain transformation texture. The latter was thoroughly investigated and geometrically established. It is assumed that decomposition of the β crystals starts from the energetically most unstable planes and that certain planes of the α crystals build up from the liberated atoms in an orientated position with reference to the β crystals (similar to the conditions prevailing in heteropolar crystals). EF (10)

Constitutional Diagram and Magnetic Properties of Platinum-iron Alloys (Zustandsdiagramm und magnetische Eigenschaften von Platin-Eisen-Legierungen) L. Graf & A. Kussmann. *Physikalische Zeitschrift*, Vol. 36, Aug. 15, 1935, pages 544-551. In a series of Pt–Fe alloys whose structure was determined by miscroscope and X-rays, the following observations were made on the Fe side of the binary system, the saturation magnetization increases due to the addition of Pt to Fe by about 10% and then drops again owing to the appearance of the face-centered crystals. Structural peculiarities of the α phase were not noticed. At 26 at. % Pt, the alloy consists almost entirely of γ crystals and is no longer ferromagnetic. Between 30 and 70 at. % Pt, strong ferromagnetic effects (Curie point up to 450°C. were again found due to the occurrence of the face-centered cubic γ solid solution which changes into the still ferro-magnetic compound FePt below 1200°C. FePt is body-centered cubic (with $a = 2.88$ A.U. and without superstructure) and has a Curie point which is 100°C. higher than, and a saturation magnetization different from, that of the solid solution of the same composition. In this concentration range, all Fe-Pt alloys exhibit an extraordinarily wide hysteresis loop with coercive forces up to 1800 oersteds and a remanence of 3000-4000 c.g.s., which represents the highest values of magnetic energy content known so far. The reason for the widening of the loop is the considerable lattice distortion due to the mechanism of the transformation from solid solution to intermetallic compound lattice, a mechanism comparable to that of martensite transformation. EF (10)

The Calculation of Potential Distribution in Certain Crystal Lattices. W. E. Laschkarew & A. S. Tschaban. *Physikalische Zeitschrift der Sowjetunion*, Vol. 8, No. 3, 1935, pages 240-254. In English. The "equivalent" atoms for the lattices of Li, Al, NaCl and C (diamond) have been computed. The potential distribution for some planes of these crystals has been evaluated. EF (10)

Structure of a Deformed Crystal and the Recovery Phenomenon (Der Bau eines deformierten Kristalls und die Erholungserscheinung) M. Kornfeld. *Physikalische Zeitschrift der Sowjetünion*, Vol. 7, No. 5/6, 1935, pages 608-618. The previously presented experimental evidence (See *Metals & Alloys*, Vol. 5, page MA 455 R-6, Vol. 5, page MA 578 L-8, Vol. 6, page MA 504 R-3) is re-interpreted and discussed together with data on recovery of metallic materials as established by other investigators. According to the author's hypothesis, the larger portion of the latent energy induced in a metal by cold working is located at the interfaces of dislocated "blocks," i. e. at the boundary planes along which slip takes place. The smaller portion of the cold work energy is consumed in elastic distortion of the space lattice. The elimination of the strain hardening effects due to cold work is closely connected with irreversible changes in the boundary regions of the "blocks" and are due either to the abolishment of the more severe distortions or to the complete disappearance of some boundary interfaces. EF (10)

Crystal Structure of Aluminum Compounds of the Spinel Type and of γ-Fe_2O_3 (Kristallchemische Untersuchungen über Aluminiumverbindungen mit spinell-artigem Gitterbau und über γ-Fe_2O_3). Ernst Kordes. *Zeitschrift für Kristallographie*, Vol. 91, Sept. 1935, pages 193-228. Based on a structural interpretation of γ Al_2O_3, a new explanation for the structure of ferromagnetic γ Fe_2O_3 is offered. EF (10)

The Electronic Structure of Diamond. George E. Kimball. *Journal of Chemical Physics*, Vol. 3, September 1935, pages 560-564. The method of Wigner & Seitz, as extended by Slater, has been applied to diamond, chosen as the most typical non-metallic crystal with the object of explaining the characteristic differences between metals and non-metals. It was found that the energy levels of the C atom are broadened into bands similar to the energy bands in metals. The lack of electrical conductivity is explained and other properties of the diamond are discussed. EF (10)

The Structure of Electrolytic Oxide Layer on Aluminum. E. J. W. Verwey. *Zeitschrift für Kristallographie*, Vol. 91, Sept. 1935, pages 317-320. In English. The structure of cubic γ' Al_2O_3 formed by electrolytic oxidation of Al is described as an average structure of the ratios. The unit cell contains 4 O ions in face centered positions; 2⅔ Al^{3+} ions are distributed statistically over all the interstices between the O^{2-} ions in such a way that 70% of the A^{3+} ions have coordination number 6 and 30% a coordination number 4 with regard to the oxygen. γ Al_2O_3 and γ' Al_2O_3 are intermediate cases between the amorphous and completely arranged state. EF (10)

Rolling and Recrystallization Structure of an Iron-nickel Alloy (Ueber die Walz- und Rekristallisationstextur des Nickeleisens). W. G. Burgers & J. L. Snoek. *Zeitschrift für Metallkunde*, Vol. 27, July 1935, pages 158-60. The (200) pole figure was determined for a 50% Fe-Ni sheet reduced from 0.35 mm. to 0.1 mm. by cold rolling and found to be in agreement with the findings for other face-centered-cubic metals. It is best described as a scattering about all orientations for which a {135} plan is parallel to the plane of rolling, with a [335] direction in the direction of rolling. After recrystallization in H_2 at 1100° a preferred orientation was found with a {100} plane in the surface of the sheet and a [100] direction in the direction of rolling, with not more than 10° of scatter. The same textures were found for a 35% Ni alloy and were not altered by 2.5% Cu, but completely destroyed by small amounts of Co or Al. It is suggested that the differences in recrystallization texture found among face-centered-cubic metals can be explained by differences in fragmentation processes which occur along slip planes during deformation. Anisotropy of magnetization was observed in the recrystallized foil and found to be in agreement with previous work, magnetic susceptibility being least in the [100] direction. GD (10)

Microscope as an Indispensable Tool in Metal Industry, Especially in Foundries (Das Metallmikroskop als unentbehrliches Hilfsmittel in der Metallindustrie, insbesondere in Giessereibetrieben). H. Reininger. *Metallwaren Industrie & Galvano Technik*, Vol. 33, Sept. 15, 1935, pages 389-393; Oct. 1, 1935, pages 411-417. Discussion of usefulness of metallographic investigations which emphasizes the usefulness of the microscope to the foundryman. EF (10)

The Crystal Structure of γ-Fe_2O_3 and γ-Al_2O_3. E. J. W. Verwey. *Zeitschrift für Kristallographie*, Vol. 91, July 1935, pages 65-69. In English. The cubic spinel structure of γ Al_2O_3 and γ Fe_2O_3 is described as an averaged structure with regard to the cations. The oxygen arrangement is the same as in normal spinels. The unit cell contains 32 O ions, 21⅓ cations and 2⅔ vacant positions are distributed statistically over the 24 (8 + 16) cation positions of the spinels. EF (10)

Endurance Tests on Supersaturated Magnesium Solid Solutions (Dauerstandversuche an übersättigten Magnesium-Mischkristallen) W. Schmidt & H. Vosskühler. *Zeitschrift für Metallkunde*, Vol. 27, Aug. 1935, pages 179-182. With discussion. Plastic deformation of crystalline material, as in creep, is interpreted as due to interchange of atomic positions rather than shear. It was studied in a Mg alloy containing 8% Al, 0.5% Zn, and 0.2% Mn, which exists as a solid solution above 350° C., but retains only 3% Al at 140°. Tensile strength and creep are determined at 20° and 140° for the alloy in the as-cast condition, after forging, and after forging and homogenizing at 420°. For the latter 2 materials at 20°, both properties are of the same magnitude and very much greater than for the cast sample; at 140° the tensile-strength relations are similar, but the creep in the forged material is appreciably greater than that of the annealed. The creep curve of the homogenized material shows an exceptionally steep section which is shown by hardness and tensile tests and photomicrographs to be due to precipitation. This enhanced creep due to precipitation is also found in homogenized cast alloys and is absent if the homogenization is followed by a low-temperature anneal. GD (10)

Alloys of Lithium with Mercury and (with) Indium (Die Legierungen des Lithiums mit Quecksilber und Indium). G. Grube & W. Wolf. *Zeitschrift für Elektrochemie*, Vol. 41, Sept. 1935, pages 675-681. Heating and cooling curves were made of 67 Li-Hg alloys. The Li-Hg system as constructed from these data is briefly as follows: (composition is in weight % Li). 0-0.6, Hg; 0.6-18.0, $LiHg_3$; 18.0-29.0, $LiHg_2$; 29.0-70.0, solid solutions of LiHg; 70.0-72.0, Li_2Hg; 72.0-91.0, Li_3Hg; 91.0-92.0, Li_6Hg; 92.0-100.0, solid solutions of Li. One eutectic lies at 0.6% Li and —42° C. and another at 92% Li and 160° C. Li_3Hg and LiHg (375° C. and 590° C. respectively) melt without decomposition. The upper limits of the other compounds formed peritectically are: Li_6Hg, 164° C.; Li_2Hg, 375° C.; $LiHg_2$, 340° C.; and $LiHg_3$, 235° C. In the Li-In system only one compound, LiIn, exists; it melts without decomposition at 625° C. LiIn forms with Li a continuous series of solid solutions while with In it forms only a limited solid solution. The system between 0 and 10% Li requires more work for clarification. The compounds of these systems fit into the generalization regarding alkali metal compounds of Biltz and Zintl and their co-workers. HAS (10)

Solid-solution Series $MgCu_2$-MgNiZn and $MgZn_2$-MgCuAl (Die Mischkristallreihen $MgCu_2$-MgNiZn und $MgZn_2$-MgCuAl) Werner Döring. *Metallwirtschaft*, Vol. 14, Nov. 15, 1935, pages 918-919. As $MgCu_2$ and MgNiZn are both cubic, and $MgZn_2$ and MgCuAl are both hexagonal, a series of alloys in steps of 10% were made of these groups to determine whether they formed continuous solid solutions. The alloys were melted and homogenized, and their lattice constants determined by X-rays. In both cases solid solutions were found. In the $MgCu_2$-MgNiZn series the lattice constants remain the same, while in the $MgZn_2$-MgCuAl series a continuous decrease takes place. CEM (10)

Metallography, Report of Committee E-4. C. H. Davis, Chairman. *Proceedings American Society for Testing Materials*, Vol. 35, Part I, 1935, pages 511-512. Progress report. Subcommittee I on Selection and Preparation of Samples (E. H. Dix, Jr., Chairman) has prepared an extensive revision of the Standard Methods of Metallographic Testing of Iron and Steel (E 3-24) and the Standard Methods of Metallographic Testing of Non-Ferrous Metals and Alloys (E-5-27) which is recommended for publication as Tentative. **Proposed Tentative Recommended Practice for Metallographic Testing of Ferrous and Non-Ferrous Metals.** Pages 1319-1351. The preparation, etching and examination of the following metals and their alloys are summarized from a review of 94 references: Fe, Al, Cu, Pb, Mg, Ni, precious metals, Sn, and Zn. VVK (10)

Thermomagnetic Analysis of Metallurgical Products and Its Recent Applications (L'analyse thermomagnétique des products sidèrurgiques et ses récentes applications) P. Chevenard. *Métaux*, Vol. 10, Aug. 1935, pages 194-208. A recording thermomagnetometer is described and results on various magnetic materials are discussed. GTM (10)

Intercrystalline Failure of Metals. J. C. Chaston. *Metal Treatment*, Vol. 1, Winter 1935, pages 186-190. Reviews intercrystalline fractures in metals and alloys caused by (*1*) segregation of a weak constituent at the boundaries (*2*) parting of boundaries at temperatures just below melting (*3*) creep failure at boundaries of strengthened crystals at temperatures in the recrystallization range (*4*) selective corrosion of boundary material (*5*) intercrystalline corrosion by specific agents acting only when metal is stressed (*6*) obscure mechanism possibly involving stress concentration at the crystal boundaries. At high temperatures the probable reason why creep failures are not normally intercrystalline is that the boundaries are fugitive on account of the recrystallisation which follows the application of stress gradients. 24 references. JCC (10)

The Twinning of Single Crystals of Tin. Bruce Chalmers. *Proceedings Physical Society*, Vol. 47, July 1935, pages 733-746; *Technical Publications of the International Tin Research and Development Council*, Series A, No. 20, 1935, 13 pages. Includes discussion. Single crystals of Chempur tin were grown (usually with the 001 axis normal to the axis of the specimen) in glass tubes 0.5 to 1.0 cm. in diameter by the Bridgman method, and their orientation determined by observing light reflections from the surface after etching in 5% $FeCl_2$. Twinning could be readily brought about on the 301 plane by impact, the twinned portion turning through about 5°. By applying tension, a twinned specimen sometimes reverted to its original orientation with an audible click. By striking a suspended specimen with a ballistic pendulum, the energy given out on twinning was determined to be 8×10^5 ergs per $cm.^3$ of crystal twinned. JCC (10)

Recrystallization of Cast Aluminum (Rekristallisation von Aluminium im Gusszustand) H. Röhrig. *Zeitschrift für Metallkunde,* Vol. 27, Aug. 1935, pages 175-9. With discussion. Al containing 0.02% Fe, 0.017% Si, and 0.003% Ti, and a purer sample containing 0.003% Fe and 0.002% Si, as well as an alloy of the latter with 2% Cu all showed normal radial cast structures, both when cooled from 730° to 630° over a 5-hour period and when cooled from the casting temperature to 20° in 30 seconds. When annealed at 580° for 20 hrs. these showed recrystallization, and further annealing at 610° for 20 hrs. developed very large grains. This recrystallization does not occur if the anneal has not been preceded by cooling to room temperature. Alloys with 0.002% Si + 0.15% Fe, 0.07% Si + 0.11% Fe, and 0.19% Si + 0.42% Fe showed no such recrystallization and grain growth. From this it is concluded that additions which are not in solid solution at the annealing temperatures prevent recrystallization. A sharp contrast is shown between the scalloped grain boundaries of the cast structures and the straight boundaries in recrystallized material. GD (10)

A New Dilatometer for Elevated Temperatures (En ny dilatometer för höga temperaturer) S. Pyk, B. Stalhane & T. Westberg. *Jernkontorets Annaler,* Vol. 11, Oct. 1935, pages 401-411. The instrument consists of a quartz tube, heated electrically, in which the expansion of the test piece is measured by a dial registering 0.01 mm. differences in length. HCD (10)

Influence of Lattice Distortion on Diffusion in Metals. V. G. Mooradian & John T. Norton. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 89-101. Includes discussion. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 26L/5. (10)

Grain Size and Its Influence on Steel Wire Manufacturing. B. L. McCarthy. *Iron Age,* Vol. 136, Oct. 10, 1935, pages 14-19. **Grain Size and Its Influence on the Manufacture of Steel Wire.** *Iron Age,* Vol. 136, Oct. 17, 1935, pages 23-27, 80, 82. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 26R/9. VSP (10)

Density Changes in Solid Aluminum Alloys. L. W. Kempf & H. L. Hopkins. *Metals Technology,* Jan. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 671, 16 pages. The growth of a number of Al alloys in the range 175° to 230° C. following rapid cooling from a solution heat treatment was determined. Growth was determined by micrometer measurements. In obtaining growth with time, alloys were cooled from the elevated temperature, measured, and again heated. Growth varied from nil to 0.16%, depending on composition and heat treatment. Rate of growth under isothermal conditions varies over a relative wide range with variations in composition. At a specific temperature of heating, maximum mechanical properties and maximum growth occur at different periods of time at temperature, the attainment of maximum growth requiring considerably larger periods of time than maximum hardness. Growth at room temperature was too small to be measured. 8 references. JLG (10)

Surface Magnetization and Block Structure of Ferrite. W. C. Elmore & L. W. McKeehan. *Metals Technology, American Institute Mining & Metallurgical Engineers Technical Publication* No. 656, Dec. 1935, 15 pages. Surface magnetization of polished ferrite crystals with or without Si was investigated, using the magnetic powder method. Powder technique was improved by using a true colloid of γ Fe_2O_3 in water. The mazelike patterns and the changes in these patterns brought about by suitably changing the magnetizing field led to the proposal of a block model of cubes spontaneously magnetized along <100> or <110> axes. A study of patterns on various cuts of the same crystal gave additional evidence for this structure. The size of the cubes was found to vary from 0.5 to 3 μ, depending on the particular crystal. The stability of the secondary magnetic structure with respect to the polishing procedure adopted and to magnetic history was shown. It is suggested that the segregation of foreign atoms may account for the observed stability of the block boundaries. JLG (10)

Quenching Stresses and Precipitation Reaction in Aluminum-magnesium Alloys. R. M. Brick, Arthur Phillips & A. J. Smith. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 102-118. Includes discussion. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 26R/3. (10)

Alloys of Magnesium. III. Constitution of the Magnesium-rich Alloys Containing Aluminium and Cadmium. J. L. Haughton & R. J. M. Payne. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 287-296; *Metal Industry,* London, Vol. 47, Sept. 13, 1935, page 273. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 28L/8. HBG (10)

The Determination of Certain Phase Boundaries in the Silver-zinc Thermal Diagram by X-ray Analysis. E. A. Owen & I. G. Edmunds. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 297-306; *Metal Industry,* London, Vol. 47, Sept. 13, 1935, page 273. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 503L/1. HBG (10)

Contraction of Aluminum and Its Alloys on Solidification. II. (Contrazione dell'alluminio e sue leghe all'atto della solidificazione. II.) L. Losana. *Alluminio,* Vol. 4, Nov.-Dec. 1935, pages 325-330. Pure Al contracts 6.36% on solidification. Occluded gases reduce this value slightly; thus a 100 g. sample containing 9.4 cc. O_2 and 3 cc. N_2 was found to contract 6.2%. Contraction of Al-Si alloys ranges from 5.82% for 0.42% Si to 2% for 15.17% Si. Occluded gases lower these results about 2%, i.e. from 2.00 to 1.98%. Al-Fe alloys containing 0.52-7.01% Fe, together with 0.03-0.19% Si show contractions of from 6.14-5.04%. With occluded O_2, these results are lowered to 5.72-4.18%, while with occluded water vapor they are 5.32-3.82%. The presence of Fe favors occlusion of gases. Al-Cu alloys ranging from 95.14% Al-balance Cu down to those containing 96.84% Cu-balance Al, show little variation, the alloy containing 4.86% Cu contracting 4.34%, that containing 94.12% Cu contracts 3.19%, the minimum. AWC (10)

X-ray Examination of Fine Structure and Its Value for Surface Refinement (Die röntgenographische Feinstrukturuntersuchung und ihr Wert für die Oberflächenveredlung) A. Kufferath. *Oberflächentechnik,* Vol. 2, Jan. 21, 1936, pages 15-17. Principle and methods for applying homogeneous X-rays for the determination of structure, deformation, and recrystallization phenomena in metals, vitreous and ceramic materials, and wood are explained. 6 references. Ha (10)

Use of Coloring Reagents for Observations of Constituents in Carbon Steels Under the Microscope (Sur l'Emploi de Réactifs Colorants Destinés à l'Observation Microscopiques des Aciers du Carbone) Joseph Malette. *Comptes Rendus,* Vol. 201, Dec. 23, 1935, pages 1385-1387. Etchants for steel are suggested as follows: 15 g. ammonium molybdate is dissolved in distilled H_2O, added to 100 cc. HNO_3 (1.20 sp. gr.) and filtered after 4 days. 2 cc. of this solution is added to 100 cc. ethyl alcohol (95%) and the polished steel sample immersed. 2 other chemicals used were 15 g. ammonium vanadate or 15 g. ammonium uranate added to HNO_3 and ethyl alcohol as outlined above. FHC (10)

Modification of Aluminium-Silicon Alloys. II. U. A. Klachko. *Zhurnal Obshey Khimii,* Vol. 5, 1935, pages 1299-1301. Si in solid solution was determined in untreated and modified Al-Si alloys. The untreated silumin has 0.41% Si in solid solution; the slightly modified, 0.34%; modified, 0.20%; and highly modified 0.57% respectively. Modified silumin has as little Si in solid solution as the untreated. This confirms the theory of stabilization of the ultra-microscopical particles of Si by Na. NA (10)

The Constitution and Properties of Cadmium-tin Alloys. D. Hanson & W. T. Pell-Walpole. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 165-189. Includes discussion. See *Metals & Alloys,* Vol. 6, May 1935, page MA 203L/6. (10)

Transformation Twinning of Alpha Iron. Alden B. Greninger. *Metals Technology,* Feb. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 689, 12 pages. An X-ray and optical study of the orientation relationship and habits of transformation twins in pure α Fe was made. Any one α grain may contain twin bands, contain smaller twin grains, or have a twin relationship to one or more of its neighboring grains. The habits of transformation twins are affected by varying the speed of cooling through A_3, mainly in the tendency of banding to disappear with very slow cooling. From a brief study of annealing twins it was concluded that such twins are only a minor structural constituent of annealed α Fe. The mechanisms that have been proposed to explain the $\gamma \rightarrow \alpha$ transformation in Fe would produce twinned structures, but do not account for the relationships between transformation twins found. Fe cooled through the transformation temperature was found to have a pronounced macromosaic structure, but Fe cold worked and then recrystallized in the α range did not. 14 references. JLG (10)

Sub-boundaries in a Crystal Grown by the Bridgman Method. W. H. George. *Nature,* Vol. 136, Sept. 7, 1935, page 392. A Cu single crystal showed some subboundaries or veining as has previously been seen in polycrystalline metals. CSB (10)

Extra Rings in Electron Diffraction Patterns. G. I. Finch & A. G. Quarrell. *Nature,* Vol. 136, Nov. 2, 1935, page 721. Presence of layer of grease on metal specimens gives rise to "extra" rings in electron diffraction; these rings are independent of nature of metal substrate. Other "extra" rings result from heating metals in a gas, and depend on nature of metal and gas; they are ascribed to absorbed gas. Still others are produced by amalgamation and vary with the metal amalgamated. Therefore caution is necessary in interpretation of "extra" rings. CSB (10)

Concerning Hardenable Bronzes with a Cu-Ni-Sn Base. VI. Addition of Cold Work Hardening and Precipitation Hardening (Über aushärtbare Bronzen auf Kupfer-Nickel-Zinn-Basis. VI. Addition von Kalthärtung und Ausscheidungshärtung) Erich Fetz. *Zeitschrift für Physik,* Vol. 97, Nov. 25, 1935, pages 690-698. Curves are given to show the increase in hardness versus the period of time with 2 alloys, one of 3% Ni, 8% Sn, remainder Cu and the other 2.5% Ni, 10% Sn, remainder Cu when the alloys are held at different temperatures. Cold working and precipitation hardening increase the strength of the alloy independently of each other regardless of the sequence of the 2 operations. FHC (10)

Recrystallization Accompanying an Allotropic Change. C. F. Elam. *Nature,* Vol. 136, Dec. 7, 1935, page 917. Recrystallization at an allotropic change point, similar to that occurring on heating a cold-worked metal, can be seen in NH_4NO_3, KNO_3 or $AgNO_3$ on a microscope slide, viewed with crossed Nichol prisms. Nuclei occur first at crystal boundaries or at an inclusion or blow hole. A cover slip pressed down on the fused salt slows down the recrystallization process conveniently. CSB (10)

Tests to Insure Tube Quality. Harry F. Dart. *Electronics,* Vol. 9, Feb. 1936, pages 32-33. Filaments of electron tubes are subjected to metallographic examination to insure proper functioning and long life. Large, elongated grains are desired. They are obtained by special heat treatment. Methods are briefly described. DJM (10)

The ϵ, γ and β Phases of the System Cadmium-Silver. P. J. Durrant. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 155-164. See *Metals & Alloys,* Vol. 6, May 1935, page MA 205L/3. (10)

Isotopic Constitution of Uranium. A. J. Dempster. *Nature,* Vol. 136, Aug. 3, 1935, page 180. Spectroscopic evidence is found for actino-U, an isotope of U of atomic weight 235. This is probably the parent of the actinium series of radioactive elements. There is about 0.4% as much of it on the earth as there is U. CSB (10)

Isotopic Structure of Iridium. A. J. Dempster. *Nature,* Vol. 136, Dec. 7, 1935, page 909. Confirms existence of 2 Ir isotopes of mass numbers 191 and 193, and 5 Pt isotopes. CSB (10)

Iron-carbon-silicon Diagram (Le Diagramme Fer-Carbure-Silicium) A. Dawans. *Revue Universelle des Mines,* Vol. 11, Dec. 1935, pages 541-552. Binary diagrams Fe-C, Fe-Si, and Si-C are explained and from them the ternary diagram Fe-C-Si is derived and discussed from the point of view of the practical foundry and steel worker. 12 references. Ha (10)

Variation in the Lattice Constant of Zinc Oxide. V. E. Cosslett. *Nature,* Vol. 136, Dec. 21, 1935, page 989. Zn oxide skimmed from molten Zn is unsuitable for a reference substance in electron diffraction studies since it is found to change its lattice constants appreciably in a few months. CSB (10)

Metallography of Steel (Metalografia del acero) J. Castells Ruiz. Jose Bosch, Barcelona, Spain, 1933. Fabrikoid, 6 x 8½ inches, 667 pages. Price 30 Psts.

The author is the head of the metallographic laboratory of a Spanish firm making aviation motors, and is also professor in the trade school of Barcelona. Beside this experience, he has worked in Continental steel plants and studied at Freiberg. The scientific and industrial background of the author allows him to deal with his subject in a practical way and from the engineering viewpoint. The subject matter covered is that normal to such treatises, but the relation of theory to practice, especially in connection with defects that need to be avoided in aviation material, is brought out more clearly than in the average treatise. The book is nicely printed and well bound. Reproductions of micrographs are especially well done.

Steel making is briefly discussed, solidification, working and heat treatment quite clearly dealt with, and alloy steels considered at some length. The final chapters deal with carburizing and nitriding. Ruiz gives considerable attention to the claims of Mahoux of Paris to the effect that high-frequency electric impulses during the nitriding process hasten the process and improve the product, and appears to be satisfied that the claims are justified, though he seems to be echoing the inventor's ideas rather than speaking from first-hand knowledge. In most other respects the information is confined to well accepted facts. Now and then a practice slightly antiquated from the U. S. point of view, is cited as normal, but on the whole, the Spanish practice, as reflected in the book, is quite up to date.

The volume is a decidedly good elementary treatise which should be very well received by metallurgists of the Spanish-speaking countries.

H. W. Gillett (10) -B-

The Structure of Metals and Alloys. W. Hume-Rothery. Monograph and Report Series, No. 1. Institute of Metals, London, 1936. Limp cloth, 5½ x 8½ inches, 120 pages. Price 3s. 6d.

This is a sort of correlated abstract, which attempts to show what the accumulated work of the last 15 years in crystal structure of metals and alloys allows one to conclude in terms of fundamental principles, which might permit some degree of prediction of behavior. About 300 references are given.

Starting with electron arrangement, crystallographic structure and atomic radii of the elements, the reader is led through solid solutions, the electronegative valency effect, relative valency effect, favorable size factor, etc., into forms of liquids and solid solubility curves, then to super lattices and intermediate phases and finally to imperfections in crystals.

The idea has long persisted that if we knew enough about the similarities and differences in the atomic make-up of metals, much of the information about any alloy system could be calculated from a few fundamental constants. We are still a long way from doing so, yet by relating the behaviors of different systems back to the electron configuration, atom size etc., by which coefficients of equivalents may be calculated, a rather plausible case may be made out to show that an alloy system is not a law into itself, but instead follows a pattern laid down for it in the properties of the elements. Whenever a general law is sought, plenty of exceptions and unexplained instances crop up, and many more years of accumulation of facts and attempts at their interpretation must ensue before a book of this sort can be classed as directly useful in the industrial laboratory, if, indeed, that time ever arrives. The groping for fundamental laws is, however, being done somewhat less blindly and with more hope of finding something that will remain reasonable when still more facts are brought forward, than was the case in many of the earlier discussions of the general topic.

The book is not easy reading, but is more readable, more interesting and more informative than most of its type. The author does not give the impression that he thinks that many of his attempts at correlation and explanation will hold water very long, he merely presents matters as he sees them at the moment. Whether the topic ever can be made really clear is a question, but the author has made a gallant attempt at clarification of a most complex subject.

H. W. Gillett (10) -B-

Conditions Determining the Intensity of X-ray Reflections from Microcrystalline Layers. J. Brentano. *Nature*, Vol. 136, Dec. 21, 1935, page 988. Discussion of focussing conditions in method of Stephen & Barnes (*Nature*, Vol. 136, 1935, page 793). CSB (10)

X-Ray Powder Photography of Alloys. A. J. Bradley. *Aluminium & the Non-Ferrous Review*, Vol. 1, Dec. 1935, pages 90-92. A general account of the use of X-ray methods in establishing equilibrium diagrams. Reference is made to the study of the Ni-Al and Cu-Al systems. JCC (10)

Macrographic Tests of Plates. *Journal of Commerce, Shipbuilding & Engineering Edition*, Nov. 7, 1935, page 5. The method and procedure to be carried out in macrographic tests on ship plates for the determination of structure particularities and local irregularities are described with special reference to the selection of test pieces, methods of attacking the surface, and photographic methods. JWD (10)

Etching Methods for Micrographic Studies of Nickel and Monel Metal. D. E. Ackerman & R. H. Schaefer. *Inco*, Vol. 13, No. 3, 1935-36, pages 24-25. A reliable and rapid method is described for showing the microstructural features of Ni and Monel metal. Ha (10)

The Interpretation of the Equilibrium Diagram. N. P. Allen. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 50, Session 1934-35, pages 98-119. A general discussion of simple equilibrium diagrams, and connection between atomic structure and mechanical properties, constituents of alloys, complex alloys, ordered and disordered states. GTM (10)

Oxidation of a Crystal Surface Studied by Means of Cathode Ray Reflection. Tasaburô Yamaguti. *Proceedings Physico-Mathematical Society of Japan*, Vol. 17, Series III, Nov. 1935, pages 443-454. In English. Effects of oxidation and of etching of cleavage surfaces of Zn blende on the reflection of cathode rays were investigated. Diffraction patterns proved that the oxidized product ZnO of Zn blende was a single crystal being so oriented that the (103) plane of ZnO was resting on the cleaved surface (110) of ZnS and that the [010] axis of the former is found to be parallel to the $[1\bar{1}0]$ axis of the latter. By taking into consideration the temperature effect in Waller's sense, a new interpretation is given of the formation of N-patterns. WH (10)

Cinematographic Record of the $\alpha \rightleftarrows \gamma$ Iron Transformation as Seen by the Electron Microscope. W. G. Burgers & J. J. A. Ploos Van Amstel. *Nature*, Vol. 136, Nov. 2, 1935, page 721. Using an electron microscope with one magnetic lens the microstructure of Fe was visible on the fluorescent screen even below 900° C. Surface of Fe was activated by evaporated Ba or Sr oxide. Image was photographed every 4 sec., giving cinematographic record. Grains of α Fe were seen to grow gradually into those of γ Fe when temperature was lowered slowly through transition point, thus differing from formation of martensite out of austenite, which is known to be sudden. CSB (10)

An X-ray Examination of Atomic Vibrations in Zinc and Cadmium. G. W. Brindley. *Nature*, Vol. 137, Feb. 22, 1936, page 316. X-ray scattering factors measured with Cu Kα radiation for Zn and Cd are a function of the orientation of the reflecting planes with respect to the c axis. This effect is too large to be attributed to assymmetry of atoms, but may be explained in terms of a greater thermal vibration of atoms along the c axis than normal to it, which is in accord with Grüneisen and Goen's theory of thermal expansion for these metals. CSB (10)

The Modification of Carpenter and Elam's Method of Producing Single Crystals of Aluminium by Deformation and Annealing. Vaughan H. Stott. *Transactions Faraday Society*, Vol. 31, Aug. 1935, pages 998-1000. Method of rolling Al is of great importance. Slight differences in the rolling can be eliminated by stretching the specimen 10%, and even 15%, after the first anneal of 6 hours at 550° C. and repeating the annealing. For the last annealing the temperature is raised at the rate of 10° C. per day, from 450° C. to 640° C., and then maintained at a temperature of 640° C. to 645° C. for a few days. 6 specimens are usually annealed together and not less than 4 crystals are obtained, 7″ long and ¾″ diam. An extension of 1.7% before the last anneal is necessary. This is probably close to the optimum value. To drill a 1/16″ hole, the crystal is carefully bored with a very sharp drill and annealed at a temperature rising slowly to 614° C. Etching will then show if the specimen is satisfactory. PRK (10)

New Technique for Obtaining X-ray Powder Patterns. R. A. Stephen & R. J. Barnes. *Nature*, Vol. 136, Nov. 16, 1935, page 793. New method for producing X-ray diffraction pattern of surface of metallographic specimen, giving sharp diffraction lines. A slit is placed between specimen and film, is oscillated with specimen, and transmits the diffracted beams only when they make a small angle with specimen surface. CSB (10)

The Deformation Lines in Alpha Brass. Carl H. Samans. *Journal Institute of Metals*, Vol. 55, No. 2, 1934, pages 209-213. See *Metals & Alloys*, Vol. 5, Dec. 1934, page MA 581. (10)

Specific Heats of Iron Nitrides. Shun-ichi Satoh. *Scientific Papers Institute of Physical & Chemical Research, Tokyo*, Vol. 28, Dec. 1935, pages 135-139. In English. A series of Fe-N alloys was prepared from Fe oxide by dissociation of Fe oxalate and reducing with H. NH_3 was passed over for 100 hours at 450° C. The mean specific heat of the alloys was determined between 0° and 100° C. in an ice calorimeter provided with evacuated walls. From the curve showing the relation between the specific heats and N content, the specific heats of Fe_4N and Fe_2N were derived. The former is 0.1242 and the latter 0.1343. The specific heats of the alloys increase linearly up to 5.9% N, (Fe_4N) the alloys consisting of α and γ' as is shown by Lehrer's diagram (*Zeitschrift für Elektrochemie*, Vol. 36, 1930, page 388). As the N content increases further, the slope of the specific heat curve increases and at 9.7% N is a maximum. This is attributed to the increasing amount of Fe_4N held in solid solution in Fe_2N (ϵ' phase range). The transformation point of Fe_4N namely $\epsilon \rightarrow \epsilon'$, is raised by the addition of Fe_4N, i.e. the transformation point is lowered by the addition of N. The alloys containing more N than 10.3% have a transformation point below 0° C. WH (10)

Metals, Mattes, Slags and Dross from the Point of View of Modern Chemistry (Les Métaux, les Mattes, les Laitiers et les Scories du Point du Vue de la Chimie Moderne) Maurice Rey. *Revue Universelle des Mines*, Vol. 12, Jan. 1936, pages 11-20. An attempt is made to explain the phenomenon of fusion, and particularly that of solubility of molten substances in one another, by applying the modern chemical theories. Chemical compounds are divided into ionic, atomic, and metallic combinations. The ionic compound is exemplified by NaCl, the 2 ions attract each other electrostatically. The atomic compound can consist of a homopolar or atomic combination having independent molecules or those having chains or crystalline lattices like the diamond. The metallic combination is characterized by certain electrons which are removed from the ions but are not divided up between the other atoms and travel about in the whole crystal lattice. The various groups are due to the deformation of the ions which cannot be considered as entirely rigid and indeformable structures; intratomic forces and electrostatic forces act against each other and cause a deformation of the ions. The deformability of anions and cations is different and has been determined by measuring the refractive index of the metal compound; Grimm has established a series of increasing deformabilities: Fe, NO_3, SO_4, CO_3, Cl, Br, I, O, S, Se; a table shows a classification of binary compounds according to these groups indicating which kind of compound is formed and their mutual solubility. The theory is discussed at length, and the expectation expressed that some day it will be possible to predetermine by the atomic theories melting and boiling points and even the form of binary and eventually ternary diagrams. 6 references. Ha (10)

A Semi-automatic Potentiometer for Thermal Analysis. R. J. M. Payne. *Journal of Scientific Instruments*, Vol. 12, Nov. 1935, pages 348-355. A mechanically driven potentiometer for use in conjunction with an inverse-rate recorder is described. The adaptability of the combined instruments to other purposes is considered possible. RAW (10)

X-ray Study of Copper-silver Alloys. E. A. Owen & Joseph Rogers. *Journal Institute of Metals*, Vol. 57, No. 2, 1935, pages 257-266. See *Metals & Alloys*, Vol. 6, Aug. 1935, page MA 332R/5. (10)

X-ray Investigation of Certain Copper-tin Alloys. E. A. Owen & John Iball. *Journal Institute of Metals*, Vol. 57, No. 2, 1935, pages 267-286. Includes discussion. See *Metals & Alloys*, Vol. 6, Oct. 1935, page MA 409L/6. (10)

Effect of Prolonged Superheating in the Mechanical, Microscopic, and Macroscopic Characteristics of an Aluminum Alloy With and Without Addition of Titanium (Studio sull'effetto di un surriscaldamento prolungato sulle caratteristiche meccaniche macroscopiche e microscopiche di una lega di alluminio in presenza od assenza di titanio) A. Vivanti & R. Guastalla. *Alluminio,* Vol. 4, Sept.-Oct. 1935, pages 271-297. Effect of superheating on an alloy containing Cu 10%, Si 1%, Fe 0.5%, and Al the remainder, as well as this same alloy plus 0.2% Ti, has been studied. The temperatures of pouring were 660° and 800° C., the material being held at these temperatures for 1 and 2 hours before pouring. Superheating does not produce any injurious effects, and it improves those poured at 800° C. In any case, addition of 0.2% Ti neutralizes all the effects of superheating.
AWC (10)

Nickel-manganese System. II. (Über das System Nickel-Mangan. II.) S. Valentiner. *Zeitschrift für Physik,* Vol. 97, Nov. 25, 1935, pages 745-757. The Curie points for Ni-Mn alloys were reported as follows:

% Mn	Curie Point, °C.
10	230
15	133
20	68
25	450
30	480

FHC (10)

Age-hardening of Magnesium-aluminum Alloys. A. M. Talbot & John T. Norton. *Metals Technology,* Feb. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication,* No. 692, 13 pages. Alloys were made from high-purity metals and contained approximately 10% Al. The process of aging at different temperatures was followed by measurements of hardness, electric resistivity, dilatation and lattice parameter, and by microscopic observation. Results proved that age hardening was due to the precipitation of a second phase from a supersaturated solution. The precipitation takes place very unevenly and may go to completion in one region before a neighboring region has started. There was no abnormal behavior of the properties measured that indicated the presence of any sort of pre-precipitation hardening phenomenon. JLG (10)

Type Metal Alloys. Frances D. Weaver (Mrs. Harold Heywood). *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 209-240. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 295L/4. (10)

Concerning a Peculiar Phenomenon at Transformations which Occur Over a Range of Temperature (Ueber eine besondere Erscheinung bei Umwandlungen, die sich über ein Temperaturgebiet erstrecken) A. Schulze. *Zeitschrift für Metallkunde,* Vol. 27, Nov. 1935, pages 251-255; *Physikalische Zeitschrift,* Vol. 37, Jan. 15, 1936, pages 41-43. The work of the author and other investigators upon the thermal properties of AuCu, $AuCu_3$, Ni, Fe, β brass and Ni-Fe and Ni-Cu alloys is reviewed with the object of demonstrating the striking resemblance in the behavior of these properties at about the temperature of magnetic transformation, in the cases of the ferromagnetic metals, and of the superlattice transformations in the case of the Au-Cu alloys and β brass. The temperature coefficient of electric resistance was shown in each instance to experience a small but sharp increase at a temperature ranging from 50° to 160° C. below that of the transformation (AuCu 220° C., $AuCu_3$ 230° C., Ni 210° C., Fe 670° C., β brass 270° C., Ni-Fe (17%) 410° C., and Ni-Cu (10%) 175° C., the transformations occurring at AuCu 420° C., $AuCu_3$ 395° C., Ni 350° C., Fe 720° C., β brass 445° C., Ni-Fe (17%) 550° C. and Ni-Cu (10%) 285° C.) and then to rise to a sharp peak at or very slightly below the transformation temperature. Similarly the temperature coefficients of thermal expansion were found to suffer slight discontinuities at the above mentioned temperatures followed by pronounced increase at the transformation. No deductions were drawn from these observations, but it is clearly implied that the magnetic and superlattice transformations must be analogous. 13 references. EF + FNR (10)

Effect of Uranium on the Structure, Hardenability, and Resistance to Tempering of Unalloyed Steels (Einfluss des Urans auf die Gefügebeschaffenheit, Härtbarkeit und Anlassbestandigkeit von unlegierten Stählen) H. Bennek & C. G. Holzscheiter. *Archiv für das Eisenhüttenwesen,* Vol. 9, Oct. 1935, pages 193-200. Good recovery of U without appreciable segregation was obtained on adding low-C ferro-U in the ladle to well-deoxidized melts. High-C ferro-U does not do so well because of the difficulty with which it is dissolved. Steels up to 5% U were forgeable. Two U carbides were observed. The solubility of U in austenite was indicated. Care must be taken in quenching to avoid incipient fusion because of the eutectic formed at comparatively low temperatures, about 1100° C. The depth of hardening is increased by U, the susceptibility to coarse grain growth reduced. U is a carbide-former like Cr. U gave little increase in the strength of structural steels. See also *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 146R/1.
SE (10)

Carbon in Iron (Der Kohlenstoff im Eisen) A. Achenbach. *Giesserei,* Vol. 23, Feb. 28, 1936, pages 101-107. Change in views of importance of C is historically reviewed.
Ha (10)

Microscopic Study of Ancient Bronze and Copper. C. G. Fink & E. P. Polushkin. *Metals Technology,* Feb. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 693, 28 pages; (abstract) *Iron Age,* Vol. 137, Feb. 27, 1936, pages 34-37, 106. Over 50 pieces of bronze and Cu, all over 1500 yr. old, were examined and 39 are described. The chief aim was to study effect of extremely long periods of corrosion on structure. Structural peculiarities of ancient bronze and Cu are attributable to crude methods of smelting and treating. The difference between old and modern metals is, however, not always pronounced. There are some samples of ancient metal objects that are almost free from the usual impurities and their structure is normal in every respect. There is no sign of change in or disintegration of the solid solutions or other components, except that due to corrosion; this applies even to specimens 5000 or 6000 yr. old. Microstructural features of initial corrosion and of patina rather than structure of metal give the most reliable proof of the ancient origin of the metal. Characteristic differences were found in the initial corrosion of the many specimens of widely different origin or location examined. According to variations in the selective action and in the path of corrosion, 6 typical cases or distinct types of corrosion were revealed. 92 references.
JLG + VSP (10)

11. PROPERTIES OF METALS AND ALLOYS

Internal Stress in Steel Caused by Dissolved Hydrogen Gas. Kotarô Honda & Tokutarô Hirone. *Kinzoku no Kenkyu,* Vol. 13, Apr. 1936, pages 121-126. In Japanese. The internal stresses in metal caused by the evolution of dissolved diatomic gas into small fissures present in the metal block during cooling are calculated by the equation,

$$p = \frac{K^2}{4V'^2}\left\{\sqrt{1 + \frac{4K_e\sqrt{p_eV'}}{K^2}} - 1\right\}$$

where p is the pressure of hydrogen gas in fissures,
K, the solubility constant of hydrogen in steel,
V′, volume of fissure per 1 g. of steel,
K_e, at the m.p. of steel,
P_e, pressure of hydrogen gas at m.p. which is in equilibrium with the molten steel,

It is found that the amount of the stress increases with the fall of temperature reaching a maximum at 300°-100°, then diminishes linearly and vanishes at absolute zero. Bennek, Schenck and Müller's hydrogen theory on the generation of flakes in steel, which is based upon an erroneous assumption, is criticized. According to the authors' theory ways to prevent the occurrence of flakes are: (1) to decrease the amount of hydrogen dissolved, (2) to avoid the segregation of inclusions, (3) to finish the transformation of steel or Ni-Cr steel above 400° C.
KT (11)

Temperature Relation of Plasticity (Zur Temperaturabhängigkeit der Plastizität) H. Eckstein. *Zeitschrift für Kristallographie,* Vol. 92, Dec. 1935, pages 253-274. Experiments on low melting metal crystals showed that their plastic behavior depends but little on temperature and that at extremely low temperatures (1.2°K.) a marked degree of plasticity is still preserved. It was concluded that plasticity is not a result of thermal atom movements but that the fundamental underlying phenomenon is of a non-thermal ("athermisch") nature onto which thermal effects become superimposed with rising temperatures. The present paper intended to reveal whether or not high melting metals as for instance W, ion-crystals (NaCl) and amorphous matter exhibit the same behavior. The former 2 materials confirmed that plasticity of crystalline materials is actually largely independent of temperature. Bakelite however, showed considerable changes of initial plastic stresses of 16°-60° C. which is in agreement with the thermal theory of plasticity.
EF (11)

The Ultimate Strength of Metals. E. N. daC. Andrade. *Science Progress,* Vol. 30, Apr. 1936, pages 593-610. The nature of the strength of a metal, theories on cohesion, mechanism of gliding and hardening and the structure of a metal as determining factors of the strength of a metal are discussed in the light of modern theories.
Ha (11)

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Copper and the Copper Alloy Metals. James T. Kemp. *Paper Trade Journal,* Vol. 102, Feb. 6, 1936, pages 35-43. Cu and its commercial alloys are described. The physical properties of Cu can be varied at will within the limits of severe cold working on one hand and soft annealing on the other. Other metals are added to Cu to make a series of ductile alloys, within definite limits of composition, all stronger than Cu, with variable properties, and capable of being hardened by cold work or softened by annealing. Brasses, bronzes, Al bronzes, Cupro-nickels and "nickel silvers," the Cu-Si types and others are produced in sheet, rod, wire, and other wrought forms. Be-Cu is a recent development which with appropriate heat treatment attains physical properties equal to those of heat-treated steels. Tensile properties of the various alloys discussed are presented in tabular form. Corrosion resistance of these alloys is discussed. Data are presented on rates of corrosion by SO_2, dilute H_2SO_4, salt spray, and actual sulphite mill exposure.
CBJ (11a)

Precious Metals as Materials of Construction. F. E. Carter. *Metal Industry,* London, Vol. 47, July 26, 1935, pages 81-84. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 411R/9.
HBG (11a)

Lithium: Theoretical Studies and Practical Applications. H. Osborg. *Metallurgist,* Vol. 1935, page 71. Extended abstract. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 506R/9.
VVK (11a)

Free-Cutting Aluminium. L. W. Kempf & W. A. Dean. *Metal Treatment,* Vol. 1, Autumn 1935, pages 146, 151. Summary of article in *Metal Progress.* See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 30L/1.
JCC (11a)

Plasticity and Practical Behavior of Cast Light Alloys with Reference to the Bending Test (Plasticita e pratico Comportamento delle Leghe leggere gettate in Relazione alla Prova di Flessione). L. Locati. *Industria Mecanica,* Vol. 17, Sept. 1935, pages 803-807; Oct. 1935, pages 892-898. It was investigated what part the plasticity of a material plays in parts which are stressed beyond their elastic limit, and if the bending test can give sufficient indication as to the later practical behavior of a cast light metal. The tests showed clearly that the plasticity of the material helps the stresses of unforseen origin to remain in limits below the danger point even if they exceed the normal value. The other mechanical properties, however, such as elongation, must not be overlooked in this connection. The bending test alone will not give sufficient indication of behavior under stress, it can only give a certain quality factor which must be considered together with ultimate strength, elastic limit, maximum deflection in bending. 12 references. Ha (11a)

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Modulus of Elasticity, Elastic Limit and Softening Limit of Light Alloys (Modulo d'Elasticitá, Limite Elastico e Limite di Suervamento Nelle Leghe Leggere) M. Prever. *Industria Meccanica,* Vol. 12, Dec. 1935, pages 1041-1047. Elastic properties of Al alloys after various heat treatments are tabulated. The yield point is defined as that load which produces a permanent elongation of 0.2% after 2 min. of action of each individual increment of load. The results show particularly that the modulus of elasticity varies with the load, and that the elastic limit and yield point are more useful than tensile strength. Ha (11a)

Amorphous Antimony. J. A. Prins. *Nature,* Vol. 136, Aug. 24, 1935, page 299. Sb distilled in high vacuum is amorphous like a supercooled liquid; it gives an electron diffraction pattern of broad bands. Heating at 120°-150° C. crystallizes the deposit, producing many sharp diffraction rings. If deposit is extremely thin, the crystallized grains are small giving slightly widened rings. Orientation of crystalline deposit is random (crystallization at room temperature gives preferred orientation: *Nature,* Vol. 131, 1933, page 760). Scratching or heating to 97° ± 2° C. causes explosive crystallization. Electrodeposits of explosive Sb are probably small particles of amorphous Sb surrounded by monomolecular films of the salt electrolysed. CSB (11a)

Non-ferrous Alloys Available for the Use of Industry. *Aluminium & the Non-Ferrous Review,* Vol. 1, Nov. 1935, pages 55-58; Dec. 1935, pages 87-88. Lists the composition and properties of the following: the Ce-Al alloys, Ceralumin B, C and D; the Al alloys, "L5," "L8," "Y" and Alpha, Beta and Gamma Alpax; Zn base, Mazak Nos. 2, 3, 5 and 6; the Mg Elektron alloys (11); and Sterling Metal alloys SM 82, SM 101 and SM 116. JCC (11a)

Tungum Alloy. *Aluminium & the Non-Ferrous Review,* Vol. 1, Dec. 1935, pages 115-116. The properties of tungum alloy (composition not given) are described, with notes on its casting, forging, joining, and machining. Good corrosion resistance, particularly to sea-water, is an important characteristic. Figures for loss of weight after immersion in a number of reagents are listed. Tensile strength varies from 20 tons/in.^{2} (cast) to 90 tons/in.^{2} (wire). JCC (11a)

Research on Thin Layers of Tin and Other Metals. (1) The Influence of Thin Metal Layers on the Deterioration of Technical Insulating Oils. P. J. Haringhuizen & D. A. Was. *Technical Publication of the International Tin Research & Development Council,* Series A, No. 29, 1936, 7 pages. Reprinted from *Proceedings Koninklyke Akademie van Wetenschappen te Amsterdam,* Vol. 38, 1935, pages 1002-1006. Deterioration of insulating oils in contact with Sn, Pb and Cu was studied by heating the oils at 90° C. in contact with glass alone and with glass coated with metal films obtained by high vacuum evaporation. Quantitative determinations of the sludge formation and change in color after 1000 hours showed Cu to give the greatest deterioration, Pb less and Sn the least. With 2 of the 3 oils deterioration was less with Sn present than with glass alone, indicating that Sn may act as an anti-oxidant. Tests made every 200 hours showed the increase of acidity of the oil to be greatest with Cu and least with Pb for the first 1000 hours. After about 1200 hours the acid value in presence of Pb rapidly exceeded that of the other metals, hence the ultimate increase in acidity was least in the presence of Sn. BWG (11a)

Elasticity Measurements on Aluminum at Elevated Temperature (Elastizitätsmessungen an Aluminium bei erhöhter temperatur) J. Verö. *Royal Hungarian Palatin-Joseph University of Technical & Economical Sciences, Faculty of Mining, Metallurgy & Forestry, Sopron,* Vol. 7, Part 1, 1935, pages 163-170. Method to determine elastic deformations is described which permits taking into account more exactly than is possible in the usual methods the permanent deformation caused by creep at higher temperatures. Tests made on Al up to 340° C. are described in full. The elasticity modulus decreased from about 6500 kg./mm.^{2} to about 3650 kg./mm.^{2} at 340°. Ha (11a)

Thermomagnetic Hysteresis in Nickel Wire. Y. K. Hsü & William Band. *Proceedings Physical Society,* Vol. 47, Sept. 1935, pages 910-922. The hysteresis effects exhibited by the thermomagnetic e.m.f. produced in a 1.0 mm. diam. Ni wire subjected to longitudinal magnetic fields and tensions under different conditions of temperature distribution are studied. JCC (11a)

Experiment on the Variation of the Alternating Current Resistance of Ni in a Longitudinal Magnetic Field (Untersuchung der Änderung des Wechselstromwiderstandes von Nickel im longitudinalen Magnetfelde) M. M. Sen Gupta, H. B Mohanti & S. Sharan. *Zeitschrift für Physik,* Vol. 98, Dec. 14, 1935, pages 262-266. Authors claim a close relation between the variation in the resistance and the magnetization of Ni placed in a longitudinal magnetic field. The results with a.c. differ from those with d.c. if the hysteresis is low and if no residual resistance appears. FHC (11a)

Magnetic Properties of Solutions of Cadmium in Molten Cadmium-Chloride and of Molten Calomel. J. Farquharson & E. Heymann. *Transactions Faraday Society,* Vol. 31, Aug. 1935, pages 1004-1010. Magnetic measurements using the Gouy method with solutions of Cd and molten $CdCl_2$ and with molten calomel were made. In no case did paramagnetism appear. Thus, a subchloride, CdCl is definitely excluded. The probability of either a subchloride, Cd_2Cl_2 or an atomic solution of Cd in $CdCl_2$, was discussed. A comparison of the magnetic properties with the electrical conductivity of molten calomel led to the assumption that it consisted of Hg_2Cl_2 molecules which were to some degree dissociated into Hg^+ and Cl^-. There is an unexpected large rise in diamagnetic susceptibility when $CdCl_2$, $PbCl_2$ and Hg_2Cl_2 melt. 23 references. PRK (11a)

Tantalum and Columbium, Produced by Special Methods, Have Many Uses. C. W. Balke. *Steel,* Vol. 97, Sept. 2, 1935, pages 50, 53. **Tantalum in Chemical Plant.** *Chemical Trade Journal & Chemical Engineer,* Vol. 97, Oct. 25, 1935, page 349. See "Columbium and Tantalum," *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 76R/10. MS (11a)

California Testing Laboratories, Inc., Make Report. *Metallizer,* Vol. 5, Jan. 1936, pages 8-9. Tests on the efficiency of various insulating coatings over an electrically heated small boiler shell were made at 150°, 300°, 500°, 700° and 900° F., using ¼″ asbestos plaster, 2″ asbestos plaster, 2 coatings of Al paint and 10 coatings of sprayed Al. The following tabulation of comparative heat loss shows 2″ of asbestos to be much the best insulator but both Al paint or Al metal to be better than ¼″ asbestos.

Temp. ° F.	150	300	500	700	900
Bare boiler	100	100	100	100	100
¼″ Asbestos covering	89	89	83	68	60
Aluminum paint	78	81	87	82	73
Aluminum metal	72	71	65	61	56
2″ Asbestos	28	27	25	19	15

BWG (11a)

The Longitudinal Thermoelectric Effect: (2) Nickel in Longitudinal Magnetic Fields. T. H. Pi & William Band; **(3) Aluminium.** M. K. Li & William Band; **(4) A Further Study of Aluminium.** William Band. *Proceedings of the Physical Society,* Vol. 47, Sept. 1935, pages 852-872. The thermoelectric forces produced in wires by assymetrical heating was measured. With Ni wires, the influence of a magnetic field was examined, and all effects agreed well with previous theories. With Al discrepancies were found, which are attributed to recrystallization. JCC (11a)

The Inter-relation of Age-Hardening and Creep Performance. I. The Age-hardening of Nickel-Silicon-Copper Alloys. C. H. M. Jenkins & E. H. Bucknall. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 141-191; *Engineer,* Vol. 160, Sept. 27, 1935, pages 330-331; *Engineering,* Vol. 140, Oct. 4, 1935, pages 371-372. Includes discussion. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 76L/9. LFM (11a)

The Properties of Some Special Bronzes. D. Hanson & M. A. Wheeler. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 93-108; *Engineer,* Vol. 160, Sept. 27, 1935, page 330; *Engineering,* Vol. 140, Sept. 20, 1935, pages 312-313; *Metal Industry,* London, Vol. 47, Sept. 20, 1935, pages 295-299. See *Metals & Alloys,* Vol. 7, Feb. 1935, page MA 76L/6. LFM + HBG (11a)

The Behaviour of White Bearing Metals When Subjected to Various Deformation Tests. I. Indentation Tests. A. S. Kenneford & Hugh O'Neill. **II. Tensile Tests.** R. Arrowsmith. **III. Pounding Tests.** H. Greenwood. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 49-113. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 535. (11a)

Some Properties of Tin Containing Small Amounts of Aluminium, Manganese or Bismuth. D. Hanson & E. J. Sandford. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 191-207. Includes discussion. See *Metals & Alloys,* Vol. 56, Aug. 1935, page MA 334R/3. (11a)

Some Properties of Tin Containing Small Amounts of Silver, Iron, Nickel or Copper. D. Hanson, E. J. Sandford & H. Stevens. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 115-133. Includes discussion. See *Metals & Alloys,* Vol. 5, Oct. 1934, page MA 493. (11a)

The Influence of Pickling on the Fatigue-strength of Duralumin. H. Sutton & W. J. Taylor. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 149-164. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 534. (11a)

Measurements of the Thermal Expansion of Cast and Rolled Zinc. H. GOULBOURNE JONES. *Proceedings Physical Society,* Vol. 47, Nov. 1935, pages 1117-1128. When measurements of the thermal expansion of cast Zn are made with increasing temperatures, a sharp discontinuity is revealed at a temperature depending on the previous heat-treatment and the size of the Zn crystals. It is suggested that the growth of the crystals during the experiment influences the expansion. In rolled Zn, discontinuities were found to be associated with the long axes of the crystals most of which are oriented perpendicular to the plane of rolling. Continuous-cooling curves, on the other hand give reliable results. Expressing expansion by

$$L = L_0(1 + \alpha T + \beta T^2 + \gamma T^3 + \delta T^4)$$

the follow average values for the constants were found:—

	$\alpha \times 10^6$	$\beta \times 10^9$	$\gamma \times 10^{12}$	$\delta \times 10^5$
Cast Zn unannealed	27.84	—47.52	178	—18
Cast Zn annealed	29.65	10.84	—68.4	129

JCC (11a)

Alloys of Magnesium. II. The Mechanical Properties of Some Wrought Magnesium Alloys. W. E. PRYTHERCH. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 133-154. Includes discussion. See *Metals & Alloys,* Vol. 6, July 1935, page MA 298R/3. (11a)

Crystal Densities of Industrial Brasses from X-ray Data. E. A. OWEN & LLEWELYN PICKUP. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 215-228. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 535. (11a)

Lithium Metal and Alloys. H. OSBORG. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Oct. 26, 1934, pages 293-294. From paper read before the Electrochemical Society. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 506R/9. MS (11a)

The Improvement of White Bearing Metals for Severe Service: Some General Considerations. D. J. MACNAUGHTAN. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 33-47. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 534. (11a)

Crystal Re-orientation on Heating Drawn Copper Wires. G. S. FARNHAM & HUGH O'NEILL. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 201-208. See *Metals & Alloys,* Vol. 5, Oct. 1934, page MA 493. (11a)

Elongation Values of Copper and Copper-rich Alloys. MAURICE COOK & EUSTACE C. LARKE. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 165-188. Includes discussion. See *Metals & Alloys,* Vol. 6, Jan. 1935, page MA 33. (11a)

Note on the Effect of Interrupted Straining on the Elongation of Lead. J. C. CHASTON. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 109-119. Includes discussion. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 372L/9. (11a)

Experiments in Wire-drawing. IV. Annealing of H.-C. Copper Wires of Varying Hardness-elongation Values. W. E. ALKINS & W. CARTWRIGHT. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 189-199. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 535. (11a)

New Aluminium Alloy. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, July 13, 1934, page 25. Outlines properties of Ceralumin. See *Metals & Alloys,* Vol. 6, Jan. 1935, page MA 33R/2. MS (11a)

Porous Bronzes (Le Bronze poreux) A. CHAPLET. *Cuivre et Laiton,* Vol. 8, Nov. 30, 1935, pages 502-503. The first porous metals were made from alloys such as those of Pb containing 50% Sb. The metal was permitted to solidify partly and the liquid material filling the interstices of the Sb crystalline network displaced by either CO_2 or oil. Commercial porous bronzes ("Oilite") are made by partially sintering or welding under pressure and heat a mixed powder consisting of 90% Cu, 10% Sn. The finished "bronze" contains about 40% voids. Ha (11a)

The Hardenable Bronzes of the Copper-Nickel-Tin Type. II. Wrought Alloys (Ueber aushärtbare Bronzen auf Kupfer-Nickel-Zinn-Basis. II. Knetlegierungen) E. FETZ. *Metallwirtschaft,* Vol. 15, Feb. 14, 1936, pages 167-170; Feb. 21, 1936, pages 189-191. Hardness-temperature curves are plotted for Cu and its alloys with 5 and 12% Sn, 15 and 20% Ni which have been reduced to ¼ their original thickness before annealing. The Sn alloys show greater hardness and lower recovery temperatures, but they cannot be worked as much. Cu-Ni-Sn alloys with 0-15% Ni + Sn are treated similarly and the hardening and capacity for reduction are shown to be additive properties. Rates of hardening at 250°, 300°, and 350° C. are determined for 2 Cu-Ni-Sn alloys which have been cast, forged, and cold rolled 25-75%. The rates increase in the order listed and the curves also show that hardening without recovery is possible below 300°. These rates show anomalous concentration and recovery effects which cannot be explained by the data from the binary alloys. Composition-hardness curves for alloys of Cu with Sn, Ni, and Sn + Ni show greater hardness for chill cast than sand cast specimens, the hardness being further reduced by annealing for all types. A direct proportionality between hardness and tensile strength is shown for all of the samples mentioned, whatever the pre-treatment. Elongation and proportional limits are also plotted, showing the great advantages obtained by addition of Ni in both the cast and treated condition. GD (11a)

Recent Advances in Zinc Metallurgy. WALLACE G. WOOLF. *Mining Congress Journal,* Vol. 22, Feb. 1936, pages 42-43. High-grade Zn (99.99%+) has been developed for die casting, which now takes about ⅛ of the quantity of Zn used in galvanizing, still the major outlet for this metal. Die cast Zn is used extensively in the automobile industry. Zn alloys having tensile strength of 44,000 lbs./in.², and impact strength of about 15 ft.-lb., are now used in die casting. Late developments have resulted in commercial electrolytic Zn with a purity of 99.9975%. High-grade Zn is also used in galvanizing for articles subject to extra severe bending stresses and where permanence and rust resistance are highly important, such as in telephone lines and in bridge construction. BHS (11a)

■ 11b. Ferrous ■

V. V. KENDALL, SECTION EDITOR

Steels and Alloys for Permanent Magnets (Les aciers et alliages pour aimants permanents) ANDRÉ MICHEL. *Revue de Métallurgie,* Vol. 32, Oct. 1935, pages 482-486. A review of the literature. When alloys are in solid solution, addition of a new phase increases hardnesses but does not affect coercivity. Outside of the solid solution range coercivity increases with the increase of the precipitated phase. There is no relation between hardness of an alloy and its magnetic properties. The size of the precipitated particles affects coercivity, best value being obtained with the critical size. Coercivity is affected by mechanical stresses. All contemporary magnet steels and alloys depend on the precipitation of a new phase. It might be a definite chemical compound or a new allotropic phase, as in Fe-Ni alloy proposed by Mishima. See also *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 203R/7. JDG (11b)

Vanadium Steels (Die Vanadinstähle) HANS HOUGARDY. P. u. G. Gärtner, Berlin, 1934. Cloth, 6¼ x 9¼ inches, 224 pages. Price 8 RM.

In this little volume the reader will find a brief yet quite complete presentation of what is known of the characteristics and behavior of V steels, including not only the records to be found in the technical literature but also data taken from unpublished work of the author.

The contents are divided into 3 principal parts—the properties and manufacture of V and its alloys—the constitution and properties of V-Fe alloys—and the application of V in practical Fe and steel manufacture. In the first section V ores and minerals are discussed, along with the methods of preparation of pure metal and ferro-alloys, the treatment of the V-Ti iron ores, and the methods of alloying steels with V. The second section is entirely physical-metallurgical in character, discussing constitution and the influence of V on various properties of Fe. In the third section considerable attention is devoted to the simple and complex V steels and their mechanical properties, special consideration being given to Cr-V and Cr-Ni-V wrought steels, to carburizing and nitriding steels and to cast steels. A very complete treatment of tool steels follows and among other items, a record of the published data on V cast irons.

To the reviewer the last 2 of the principal parts of the book have received the best and most complete treatment. The first is not so close to perfection as for example in the statement that the roscoelite and carnotite ores are not of current importance and the omission of Marden and Rich's excellent work in the preparation of pure V by reduction with alkali metals. An excellent bibliography is included, and although the author's names in the English and American references are not very precise, this should prove no serious inconvenience if locations have been accurately recorded. In a book of this nature critical appraisal of published data is very beneficial and more of this would have been helpful.

Jerome Strauss (11b) -B-

Steel for Steel Castings. W. WEST. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 597-614. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 335. CEJ (11b)

American Malleable Iron and Its Derivatives (Le malléable américaine et ses dérivés) RAYMOND GAILLY. *Revue de Métallurgie,* Vol. 33, Jan. 1936, pages 38-42. French Railroad specification No. 19 for malleable iron specifies only that it could be deformed under a hammer to show that it is malleable and that a punch might be driven through it as easily as through soft steel. Specification No. 53 calling for min. tensile strength of 35 kg./mm.² and min. elongation of 10% in 115 mm. is never used. Brief summary of the methods employed in making it and the changes produced by various additions taken from published data. JDG (11b)

Determining the Quality of Unalloyed Tool Steel (Güteprüfung von unlegierten Werkzeugstahl) E. HOUDREMONT, H. SCHRADER & A. CLASEN. *Archiv für das Eisenhüttenwesen,* Vol. 9, Sept. 1935, pages 131-146. The behavior of 1% C tool steels, made with different furnace practice, was tested after quenching, annealing, carburizing, and decarburizing. Repeated quenching was found unsuitable for determining the sensitivity to quenching cracks. Deep hardening steels showed up poorly in bend tests of hardened samples. The cementite network in carburizing tests at 1000° C. gave indications of the sensitivity to overheating. Steels melted with "pure" (carbonyl) Fe in the charge showed more pronounced coalescence of the cementite on heating below A_1. On decarburization in moist H_2 steels with "pure" Fe in the charge seemed to give more decarburization. The technical steels were all normal. Steels with "pure" Fe in the charge were abnormal, i.e., showed coalescence of the cementite in the carburized layer. It was concluded that an abnormal structure in the McQuaid-Ehn test is not due to dissolved O but to higher purity of the charge; this causes more rapid coalescence of the cementite because Ar_1 is higher so that the pearlitic cementite formed can coalesce more readily just beneath Ar_1. SE (11b)

Iron for Relays and Electromagnets. A. S. ZAIMOVSKI. *Kachestvennaya Stal,* No. 9, 1935, pages 37-40. In Russian. Electrical properties of pure Fe are presented in the light of the contemporary literature but mostly based on Yensen and Ziegler's work. (11b)

The Kinetics of Sorption Processes of Hydrogen on Iron. N. M. MOROZOV. *Transactions Faraday Society,* Vol. 31, Apr. 1935, page 668. Three different types of sorption are shown to exist in the temperature range between —190° and +400° for the sorption of H by Fe. They are: van der Waals adsorption, activated adsorption, and activated diffusion. In certain temperature ranges it is possible to separate these processes and investigate the kinetics of each individual process. A value of $E \sim 20{,}000$ Cals. has been obtained for the activation energy of activated adsorption (for 1.0cc. of amount of gas adsorbed) and a value of $E \sim 8{,}000$ Cals. for activated diffusion. In the temperature range from 300° to 400° the activated adsorption is an instantaneous and entirely reversible sorption process. Howard's results showing that the activated adsorption diminishes the van der Waals' adsorption are confirmed. It is shown, however, that under certain experimental conditions the absence of such a relation between the 2 types of sorption is possible. 9 references. PRK (11b)

Recent Advances in Alloy Steels (Recents progrès dans les aciers spéciaux) Robert Hadfield. *Revue de Métallurgie,* Vol. 32, Dec. 1935, pages 591-613; *Metallurgia,* Vol. 13, Nov. 1935, pages 11-14; *Engineering,* Vol. 140, Oct. 25, 1935, pages 444-445. **Advance in Scientific Metallurgy.** *Heat Treating & Forging,* Vol. 22, Mar. 1936, pages 115-118. Succinct review of the whole field of alloy steel development. JDG + LFM + MS (11b)

Influence of Phosphorus on Temper Brittleness (Einfluss des Phosphors auf die Anlasssprödigkeit) H. Bennek. *Archiv für das Eisenhüttenwesen,* Vol. 9, Sept. 1935, pages 147-153. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 146R/3. SE (11b)

Special Cast Irons (Les fontes spéciales) Auguste Le Thomas & Marcel Ballay. *Revue de Métallurgie,* Vol. 33, Jan. 1936, pages 24-37; (abstract) *Journal du Four Electrique,* Vol. 45, Feb. 1936, page 60. A summary of the present knowledge of the subject based on published data. JDG (11b)

Nickel-Copper Structural Steels. *Nickel Bulletin,* Vol. 9, Feb. 1936, pages 29-33. The addition of Ni to structural Cu steels enables the producer to overcome the surface cracking of Cu steels (at least half as much Ni as Cu is required) and to obtain improved resistance to corrosion and superior mechanical properties. Composition and properties of a series of Ni-Cu, Ni-Cu-Cr and Ni-Cu-Mo steels are given in tables. Ha (11b)

Special White Cast Irons (Les Fontes Blanches Spéciales) M. Ballay & R. Chavy. *Bulletin de l'Association Technique de Fonderie,* Vol. 9, Nov. 1935, pages 366-380. French exchange paper presented at the International Foundry Congress, Brussels, Sept. 1935. An investigation of the physical properties of Ni-Cr white cast irons. Austenite-martensite structures were secured by use of alloy additions as low as Ni 3.0% and Cr 1.5%. Brinell hardness up to 800 was obtained. Same austenitic white cast irons were very resistant to acid corrosion. Among proposed uses of these materials were: (a) finishing rolls, (b) sand blast nozzles, (c) replacing tungsten carbide in certain uses, and (d) corrosion resistant equipment. WHS (11b)

Purchasing Data for Various Grades of Steel Castings. R. A. Bull. *Steel,* Vol. 98, Mar. 23, 1936, pages 36, 38, 40, 43. Summary of chemical composition and physical properties set down in all current A. S. T. M. specifications for steel castings, with explanatory text. MS (11b)

American Progress in the Use of Alloys in Cast Iron. F. B. Coyle. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 177-259. See *Metals & Alloys,* Vol. 5, May 1934, page MA 225. CEJ (11b)

Cast Iron and Steel Differentiated. A. L. Norbury. *Iron Age,* Vol. 136, Nov. 7, 1935, pages 25, 104, 106, 110, 112. See "On the Definition of the Terms 'Cast Iron' and 'Steel'," *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 141L/4. VSP (11b)

Role Played by Supplementary Elements When Added to Non-Oxidizing Steels (Role des Eléments d'Addition dans les Aciers Inoxydables) E. Pretet. *Chimie et Industrie,* Vol. 33, May 1935, pages 1061-1063. Supplementary elements added to stainless steels exercise various effects on chemical resistance of the steels. They modify the properties of the basic solid solution in which they themselves go into solution; they determine the nature and number of phases which can exist in the alloy; and they permit various heat treatments. They determine the nature of the non-metallic phases separated before and during solidification and which affect the quality of the metal. MAB (11b)

Tests of Low-Tungsten Molybdenum High Speed Steel (Versuche mit wolframarmem Molybdän-Schnellarbeitsstahl) H. Pohl. *Stahl und Eisen,* Vol. 55, Sept. 19, 1935, pages 1001-1005. Steels of about 4% Cr, 8% Mo, 2% W, and 1% V were compared with the usual 18% W, 4% Cr, 1% V composition. No difficulties in melting were encountered although greater care was necessary in heat treatment to avoid decarburization and volatilization of Mo. The best quenching temperature was at about 1200°-1220° C., considerably lower than the comparison W steel; the best tempering temperature was also lower; at about 540°-560° C. Drilling and turning tests indicated the life of both types of steel to be about equal, although in previous tests the Mo steel showed more fluctuation. SE (11b)

Impact Resistance and Other Physical Properties of Alloy Gray Cast Irons. Garnet P. Phillips. *Transactions American Foundrymen's Association,* Vol. 6, Dec. 1935, pages 125-141. To determine impact resistance of alloy cast irons, samples from 38 cupola heats and 20 electric furnace heats were tested. Alloy additions used were Cr, Mo, Ni, Cu, and Ti. In addition to impact test results, tests on other physical properties were made. 10 heats of the electric furnace irons were heat treated. The effects of the alloys on the physical properties are compared and discussed. Test results indicate that in the case of irons cast gray and omitting austenitic irons, fairly high C Ni-Mo irons that may contain some Cr, have good impact resisting properties. The highest impact resistance was obtained on irons cast white and converted to gray irons by annealing. Transverse resilience correlates fairly closely with impact resistance and single blow tests made on machined bars apparently correlate with transverse resilience more closely than does the repeated drop test on unmachined bars. CEJ (11b)

Alloyed Grey Cast Iron. Carl W. Pfannenschmidt. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 104-138. See *Metals & Alloys,* Vol. 5, May 1934, page MA 222. CEJ (11b)

Rail Steel and Rail Wear. L. Sanderson. *Metallurgia,* Vol. 13, Feb. 1936, pages 113-114. Discusses properties of different English rail steels and concludes that basic bessemer rails are inferior to rails made by acid bessemer or acid open-hearth process. Analyses and tensile properties of some rails are given. JLG (11b)

Phosphorus in Cast Iron. W. West. *Proceedings Institute of British Foundrymen,* Vol. 26, 1932-1933, pages 392-417. See *Metals & Alloys,* Vol. 5, Apr. 1934, page MA 158. CEJ (11b)

Effect of a Graphite- and Silicon-Poor Pig Iron on the Mechanical Properties of Gray Iron at Elevated Temperatures (Ueber den Einfluss eines graphit- und siliziumarmen Roheisens auf die mechanischen Eigenschaften von Grauguss bei höheren Temperaturen) M. Paschke & Fr. Bischof. *Giesserei,* Vol. 22, Dec. 20, 1935, pages 625-627. Four series of melts with charges of different compositions of pig Fe were made and are described in detail. They show that with increasing addition of special pig Fe, tensile strength, impact-hardness and notch-toughness increase at elevated temperatures. Ha (11b)

Variations in Resiliency (Variaciones en el Valor de la Resiliencia) J. Castells Ruiz. *Metalurgia y Construccion Mecanica,* Vol. 1, Feb. 1936, page 7. Curves showing the change of resiliency with the temperature applied in heat treatment are reproduced for a low C steel (0.05% C) and for a Cr-Ni steel (0.25% C, 0.78% Cr, 2.75% Ni). Ha (11b)

Typical Applications and Advantages of Alloy Steels. N. M. Salkover. *Modern Machine Shop,* Vol. 8, Jan. 1936, pages 36-46. A general review of alloy steels now available, their SAE definitions and fields of applications, composition and price. Ha (11b)

The Chilled Car Wheel. F. K. Vial. *Official Proceedings, Canadian Railway Club,* Vol. 34, Nov. 1935, pages 24-135. Includes discussion. The most widely used of the 3 types of materials for railroad car wheels (chilled iron, forged steel and cast steel) is now chilled iron because its properties are more peculiarly adapted to this kind of service than any other material and the first and ultimate costs are very low. The composition is Fe with 3.4% C. In the chilled portion of the wheel C is all combined, whereas in the gray Fe part the combined C is 0.90% or less and the graphite 2.5% or more. After an exhaustive treatment of the development and description of numerous tests for cost, economy, breaking and brake shoe qualities, rail wear and shop costs, the metallurgical aspects are discussed and heat-treating furnaces for foundries and testing methods of hardness of the wheels described. The effect of heat-treatment on the chilled Fe is to change the familiar lamellar pearlite into spheroidized pearlite. Photographs of microstructures are reproduced. The advantages of the chilled Fe wheel are summarized as follows: extremely low cost as the worn wheel is taken in part payment for a new wheel, a guarantee of 4 years under 50-70 ton cars up to 6 years under 30 ton cars, 20% greater durability of brake shoes on this than any other type of wheel, minimum abrasion of rails, reduced train resistance and low shop costs. Ha (11b)

Plastic Strain and Creep Stress. R. W. Bailey. *Journal & Record of Transactions Junior Institution of Engineers,* Vol. 46, Oct. 1935, pages 1-29. See *Metals & Alloys,* Vol. 6, June 1935, page MA 249R/2. WH (11b)

Corrosion-resistant Steels. H. Bull. *Chemical Trade Journal & Chemical Engineer,* Vol. 97, Dec. 27, 1935, pages 549-550. See "Stainless Steels," *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 86L/2. MS (11b)

The Evolution and Progress of Rust-, Acid- and Heat-resisting Steels. W. H. Hatfield. *Iron & Coal Trades Review,* Vol. 132, Jan. 17, 1936, pages 134-136. Present status of corrosion and heat resisting steels, their fields of application, and further necessary developments are discussed. Ha (11b)

Length Variations of Steel Wire During Aging Following Severe Disturbance. H. Goulbourne Jones. *Metallurgia,* Vol. 13, Mar. 1936, pages 155-157. Wire samples of 0.22" diameter and 3" long from steel with 0.06% C and 0.48% Mn were used. Length changes were measured with an optical lever that indicated changes in length as small as one part in a million. Quenching, holding in an alternating magnetic field or stressing caused subsequent small changes in length on holding at room temperature. These changes lasted for as long as 7 days, but the total amplitude of change was less than 0.02%. JLG (11b)

Meehanite Metal Creates New Standards in Iron Castings. W. H. Kinney. *Industrial Gas,* Vol. 14, Feb. 1936, pages 17-19, 25. Meehanite cast Fe is a pearlitic cast Fe with the graphite uniformly distributed throughout the Fe, with the free C in the form of small nodules surrounded by a matrix of ferrite and pearlite. The process of making this type of Fe makes it possible to control the mechanical properties according to definite specifications. Charts show the comparative strength, hardness and growth of ordinary and Meehanite cast Fe after repeated heating. Ha (11b)

Effect of Copper on Cast Fe and Cast Steel (Einfluss des Kupfers in Eisen- und Stahlguss) *Die Metallbörse,* Vol. 25, Jan. 5, 1935, pages 17-18; Jan. 12, **1935, page 51. Physical properties of Fe** in relationship to Cu contents (0.1-8% Cu) are tabulated. Fe with 2% Cu can be easily forged at relatively low temperatures. The age-hardening results of Kinnear are presented in a table inter-relating heat treatment, Cu and C content and aging effect. The physical properties of a Cu bearing steel with 0.16% C, 1.06% Cu, 0.55% Mn and 0.34% Si in the annealed and age-hardened state at temperatures ranging from 20°-400° C. are compared with those of a 0.38% C, 0.65% Mn, 0.139% Si steel. EF (11b)

Composite Steels for Jail Use Must Meet Rigid Specifications. *Iron Age,* Vol. 137, Mar. 19, 1936, pages 43, 65. Primary specifications for jail steels are high resistance to sawing and breaking. Composite steels of two or more distinct types and analyses have been meeting the requirements. In the construction, the important feature is in arrangement of hard steel inserts which are covered with a steel of softer composition. The arrangements of inserts form what is known as "bird-cage" type specified by New York State and in general use. In forming the flooring and roofing the so-called "five ply" type is used, consisting of 3 plies of soft and 2 plies of hard steels. The analyses of steel produced by Jessop Co., represents a practical standard for meeting current rigid requirements: *Inserts:*—C 1.45-1.55%; Mn 8.00%; Si 0.30-0.35%; Cr 4.00-4.50%; S, and P a trace. *Soft steel:*—C 0.15% max.; Mn 0.50%; Si 0.25%; S 0.020% max.; P 0.020% max. VSP (11b)

Heat Resisting Steels. *Edgar Allen News,* Vol. 14, Apr. 1936, pages 825-826. The various steels made by the Edgar Allen Co., their mechanical properties and safe working loads up to 1100° C. are described. They comprise austenitic Ni-Cr steel, austenitic Ni-Cr-W steel, austenitic high Cr-Ni steel, high Cr steel, and other Ni-Cr steels. The best fields of employment for each type are described. Ha (11b)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

Long-Time Creep Tests of 18 Cr 8 Ni Steel and 0.35 Per Cent Carbon Steel. H. C. Cross & F. B. Dahle. *Transactions American Society of Mechanical Engineers,* Vol. 58, Feb. 1936, pages 91-96. Results are given on tests which have run for 7000 and 5400 hrs. respectively and are still being continued. Both specimens, after showing at first diminishing rates due to strain hardening on account of deformation, now show increasing rates of creep as the tests progress. The change occurred in both after about 3000 hrs. No prediction as to further behavior can be made from the curves so far taken with about 8000 lbs./in.^{2} The present deformation is now less than 0.0001%/hr. Ha (12)

High-Temperature Properties of Cast and Wrought Carbon Steels from Large Valves for High-Temperature Service. H. C. Cross & F. B. Dahle. *Transactions American Society of Mechanical Engineers,* Vol. 58. Feb. 1936, pages 103-113. Two forged and 2 cast C steels were compared with regard to structure and behavior at 750°, 850° and 950° C. under short-time tension tests and impact tests. The tensile properties at room temperature were quite similar for the samples with the same C content. The forged steels show the best Charpy impact tests at room as well as at the higher temperatures. A slightly lower value is shown by the cast steel with spheroidized structure while the ordinary C cast steel has the lowest impact resistance. The forged steels showed the best creep resistance at high temperatures, the cast steels were poorer. There appears no correlation between the results of the short-time tension and long-time creep tests at the elevated temperatures. No broad generalization of cast vs. wrought or coarse-grained vs. fine-grained steels is warranted by the results, as other factors such as soundness, strength, ductility enter into the choice of C steels for specific purposes. 19 references. Ha (12)

Plasticity and Fracture of Steels at High Temperature (Plasticité et Rupture à Chaud des Aciers) M. de Lacombe. *Chimie et Industrie,* Vol. 33, May 1935, pages 793-799. Modern surgery demands steels which are less like ordinary C steels and which contain higher percentages of such elements as Cr, Ni, W, Co, etc. The manufacture of such steels is rather difficult, and many steels are not resistant to heat and high temperatures. Article covers a study of the structure of special steels and the modifications to which they are subjected at various temperatures, reviews the various kinds of defects which arise, and suggests the manner of research to make the kind of structure which is most desirable for these purposes. MAB (12)

Creep Resistance of Welded Boiler Plates (Dauerstandsfestigkeit geschweisster Kesselbleche) C. Appaly. *Die Wärme,* Vol. 58, Sept. 28, 1935, pages 639-643. Creep tests at the Technische Hochschule, Breslau, proved that a boiler plate weld, which has not been annealed, has a higher creep resistance than either the plate itself (0.085% C, 0.017% P, 0.47% Mn, 0.036% S) or the filler rod (0.09% C, 0.015% P, 0.5% Mn, 0.02% S, trace Si) due to the setting-up of internal stresses and due to the occurrence of a structure which inhibits creep. This could be definitely proved by annealing, which released the residual stresses and produced the same microstructure as in the joined plates. After annealing the same low creep resistance was obtained as with the boiler plates. It is concluded that the welded joint does not endanger the structural stability of the boiler. An accelerated creep test was used whereby the bend in the creep-load curve was utilized for the evaluation of the creep resistance. EF (12)

A Study of Cast Irons with Resistances to High Temperatures (Etude d'ensemble sur les Fontes Résistant aux hautes Températures) T. Boissaux. *Revue Technique Luxembourgeoise,* Vol. 28, Jan.-Feb. 1936, pages 1-13; Mar.-Apr. 1936, pages 33-42. A study of the reasons for changes in a cast Fe exposed to high temperatures which are (1) graphitization or decomposition of the carbides, especially Fe carbide, (2) internal stresses of thermal origin, (3) exterior corrosion and internal oxidation of the material. Methods of determining these factors are described and the influence on them by addition of alloying elements explained. The properties and compositions of heat resisting alloy cast irons are described, especially Niresist and Nicrosilal which can be used for complicated castings and will stand temperatures up to 850° C. 30 references. Ha (12)

Evaluation of Creep Tests (Die Auswertung von Dauerstandversuchen) F. Gentner. *Archiv für das Eisenhüttenwesen,* Vol. 9, Mar. 1936, pages 441-450. An analysis is made of various types of time-deformation curves of various steels at different temperatures and stresses. Experiments confirmed that at a certain test temperature and beyond a certain limiting stress the time-deformation curves are parabolic. Below this limiting stress the curves are logarithmic. Logarithmic curves do not lead to failure; parabolic curves do. Such analyses can be used for determining the creep limit. The limiting creep stress arrived at in this way is one which produces an elongation of 0.2%/yr. Such a value can be used by the engineer for design at elevated temperatures in the same way as the tensile strength is used for design at room temperature. SE (12)

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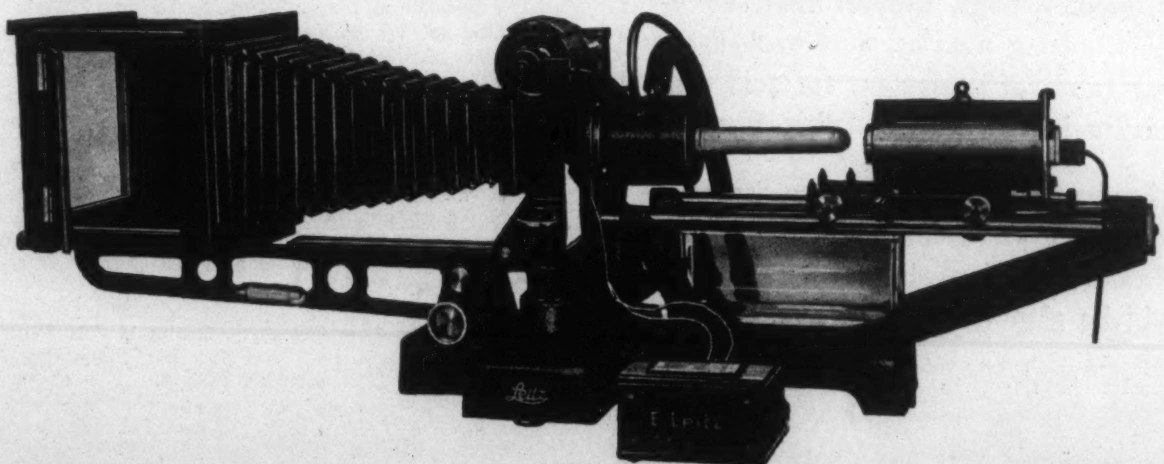

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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

Passivity of Stainless Steels of the 18-8 Type (Contribution à l'Étude de la Passivation des Aciers Inoxydable Type 18/8) J. Hochmann, J. Rist & Andre Michel. *Chimie et Industrie,* Vol. 31, Spec. No., Apr. 1934, pages 625-630. A qualitative study of the phenomena of the passivity of 18-8 steels. The influence of the following factors were studied: action of air with and without heating, effect of certain reactions, such as H_2SO_4, the effect of certain additions (arsenic, ferric salts, HNO_3, etc.) to the reactives. The constitution of steels is reviewed, particularly of Mo and Ni steels. The conclusions indicate that one should never depend on the passivity of the unstable character produced on the surface of a metal by any specific method, such as polishing. The impurities in the acids or attacking liquids produce the damage; that is the factor which the commercial user should always take into consideration, even after tests have been made, for the tests are made with pure acids or liquids. In 18-8 steels the addition of Mo facilitates the establishment of a stable passivity with the sulfonitric mixtures, and increase in the Ni and Mo content favors the passivity with arsenic. MAB (13)

The Oxide Film on Passive Iron. Wilder D. Bancroft & J. D. Porter. *Journal of Physical Chemistry,* Vol. 40, Jan. 1936, pages 37-42. A paper presented at the Twelfth Colloidal Symposium, Ithaca, June 20-22, 1935, states that the evidence brought forward by Evans & Hedges to show that the film on passive Fe is Fe_2O_3 does not prove anything in regard to this. The film making Fe passive and produced by adsorption from a ferrate solution, $K_2O.FeO_3$, is an oxide no higher than FeO_3 (Bennett & Burnham). The film making Fe passive and produced by anodic polarization of Fe in a concentrated solution of KOH is an oxide no lower than FeO_3 (Haber). Since the 2 films are the same, the composition must be FeO_3 (Bancroft & Porter). E.m.f. measurements in HNO_3 of specific gravity 1.20 prove that the same film of FeO_3 is formed when Fe is made passive by adsorption from an alkaline ferrate solution by anodic polarization in alkali, or by treatment with H_2O_2, chromic acid, acid potassium permanganate, or HNO_3 of specific gravities between 1.35 and 1.42. The activation of passive Fe by concentrated H_2O_2 is the result of heating and not of reduction. EF (13)

Determination of Wear Resistance as a Problem of Materials Testing (Die Bestimmung des Abnutzungswiderstandes als Aufgabe der Werkstoffprüfung) H. Meyer. *Archiv für das Eisenhüttenwesen,* Vol. 9, Apr. 1936, pages 501-508. Contains a review of the various wear testing methods. Wear resistance is not a property of the material but depends on the type of wear. Therefore, the wear resistance of different steels cannot be compared on the basis of a single test method. Wear tests are only useful when they closely imitate service conditions. Wear tests should, therefore, be classified not according to the set-up of the apparatus but according to the resulting type of wear, for example whether the wear is wholly metallic or whether oxide layers are formed, and whether severe cold work takes place. SE (13)

Corrosion Resistance of Aluminium and Standard Aluminium Base Alloys. P. Mabb. *Metallurgia,* Vol. 13, Feb. 1936, pages 109-113. Discusses manufacture and properties of Al alloys. The high corrosion resistance of many of the alloys has stimulated their use. Compares corrosion resistance of Al and standard Al alloys. JLG (13)

Subcutaneous Effects During the Scaling of Steel. R. Griffiths. *Industrial Heating,* Vol. 3, Jan. 1936, page 26. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 80R/8. Ha (13)

More Views on Causes of Deposits in White Metal Carburetors. *S. A. E. Journal,* Vol. 38, Jan. 1936, pages 34-35. Discussion of paper by E. L. Baldeschweiler et al, *S. A. E. Journal,* Oct. 1935. Discussers recommend use of $CaCrO_4$ wherever water can collect in order to form inhibitor by dissolution in the water. Photos of fuel pump without and with the inhibitor made up in pellet form fluxed with borax, are shown after test. With the $CaCrO_4$ present corrosion was completely inhibited. Other discussers confirm results of original paper, recommend various types of films and coatings for corrosion protection of die cast carburetors. WB (13)

Headlamps Given Electrolytic Coating of Zinc Phosphate for Rustproofing. *Steel,* Vol. 98, Mar. 9, 1936, page 42. See "Rustproofing Process," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 418R/4. MS (13)

Handling of Fatty Acids. *Chemical Trade Journal & Chemical Engineer,* Vol. 98, Mar. 20, 1936, page 241. Monel metal resists attack by stearic and oleic acids, and is employed in much apparatus coming in contact with them. Monel metal spindles in stop-valves operating in an atmosphere of C_6H_6 solvent gases, H_2O vapors containing these acids, and NH_3, have given satisfactory service for 15 years. Mild steel spindles were useless in as little as 3 months. MS (13)

Lead Corrosion in Buildings. *Chemical Trade Journal & Chemical Engineer,* Vol. 97, Aug. 9, 1935, page 123. Abstract of *Department of Scientific & Industrial Research—Building Research Board Bulletin* No. 6. Ed. 2. Pb is corroded by CaO, cement, insufficiently seasoned timber, particularly oak, and soil. For preventing corrosion, Pb may be protected by bitumen or felt impregnated with bitumen. Buried pipes may be packed in chalk, limestone, or old well carbonated mortar. MS (13)

Use of Ammonia in Corrosion Prevention. J. W. Smith. *Refiner & Natural Gasoline Manufacturer,* Vol. 14, Aug. 1935, page 395. An automatic system of introducing ammonia into a crude oil to vapor heat exchanger is described. pH was maintained at 7.0; less than 7.0 gave slight corrosion; pH greater than 7.2 will cause corrosion of brass and admiralty condenser tubes and at the same time results in the use of excess ammonia. VVK (13)

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Ships' Compositions. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Sept. 7, 1934, page 166. From *Synthetic & Applied Finishes,* Aug. 1934. Deals with formulation of anti-fouling paints. Cu bronze powder is used extensively in Europe for protecting small pleasure craft. MS (13)

Effect of Alkaline Detergents Upon Metals, Aluminum, Copper, Tin, and Zinc. Chester L. Baker. *Industrial & Engineering Chemistry,* Vol. 27, Nov. 1935, pages 1358-1364. Strips of the metals were immersed in the alkali solutions at about 60° C., and observations were made as to the effect of concentration and immersion time. After 24-hour immersion the Na silicates impaired the surface of the metals less than the other alkalies, except Na carbonate toward Zn. Na metasilicate is much used for industrial cleaning of metals, and an increasing silica content seems to give better protection to the metals. MEH (13)

The Handling and Storing of Acids. Thomas J. Dixon. *Chemistry & Industry,* Vol. 54, Dec. 27, 1935, pages 1104-1109. Suitable equipment for handling and storing the following acids is discussed: H_2SO_4, HCl, $HC_2H_3O_2$, HCOOH, and CH_3OOH. The remarks are based on the author's years of experience. Storing and conveying H_2SO_4 below 77%—Pb or TePb. The latter Pb alloy has proven far superior to Pb, due to greater resistance to cracking under stress. Above 77% H_2SO_4-mild steel and cast iron, the latter being better against abrasion. The handling of HCl is extremely difficult, in that non-metals must be used. Stoneware, glass or rubber-lined equipment were standard material until quite recently, when synthetic resins have proven useful and resistant. The handicap imposed by non-metal equipment is most realized in pumps. Ebonite covered shafts and impellers have been successful. Improvement in the physical properties of ebonite and synthetic resins are needed for HCl pumps. Pipe lines of stoneware, ebonite or rubber-lined steel are satisfactory up to 110° C. HNO_3 requires austenitic steel with acid up to 80%, and Al (99.5%) above this strength. $HC_2H_3O_2$ requires Al (99.5%) for cold acids above 90%, and either glass or ebonite lined steel for acids below 90%. HCOOH is the most difficult to handle, few materials being unattacked by either the hot or cold acid, Pb, Ag, stoneware and glass being exceptions. CH_3COOH presents few difficulties when dry, if wet, Pb or rubber lined steel must be used. AAA (13)

Problems of Pipe Line Corrosion Now Being Attacked More Scientifically. Scott Ewing. *Oil & Gas Journal,* Vol. 34, Oct. 31, 1935, pages 32-38. Paper before the Chicago 1935 meeting of the American Gas Association. In removing the third set of coated pipe in the A. G. A. test of pipe coatings the author discussed corrosion problems with a large number of commercial companies. This article contains valuable sidelights from these discussions. In general there seems to be a serious attempt on the part of the gas companies to take advantage of all that is known about coatings and corrosion. Many companies have altered their coating practices within the last few years, probably because of the coating and corrosion research of the National Bureau of Standards, the American Petroleum Institute, and the American Gas Association. Most of the companies, however, have not as yet adopted a definite coating program and policy, probably because they are skeptical as to the necessity or value of the coatings. With the data on repairs and replacements, which the average gas company has, it is usually not possible to demonstrate with a logical argument exactly where coatings should and should not be used. But a study of the data by the company will at least be of considerable help in deciding on where coatings should be used. There is believed to be a general tendency in the industry toward the more extensive use of adequate coatings. VVK (13)

Effect of Mixed Acids Upon Irons and Steels. Justice Eddy & F. A. Rohrman. *Industrial & Engineering Chemistry,* Vol. 28, Jan. 1936, pages 30-31. The results of this study show that (1) high-C steels have a greater tendency to retain their passivity in mixed acids (sulphuric-nitric) than low-C steels; (2) quenched steels exhibit a greater tendency to resist mixed acid than furnace-cooled steels. MEH (13)

The Dissolution of Magnesium in Aqueous Salt Solution. Part IV. L. Whitby. *Transactions Faraday Society,* Vol. 31, Apr. 1935, pages 638-648. Dissolution-time curves up to 24 hours were obtained at 25° in *N*, .01 *N* and .001 *N* solutions of NaCl and of Na_2SO_4, of Mg previously exposed to an indoor atmosphere for 30 minutes, 2 hours, 17 hours, or 21 days. No protection against subsequent dissolution in chloride and sulphate solutions was provided by increasing the thickness of the air-formed film. Visible films, such as those formed in 21 days pre-exposure sometimes produce an increase over the normal rate of dissolution. The effect of concentration of chloride and sulphate solutions on the corrosion rate of Mg was also investigated. Spectroscopic analysis of the 2 samples of Mg used is given. The maxima in rate of solution were observed at certain concentrations, the actual concentrations varying according to the salt, the sample of metal and the time from the start of reaction. The variation in the solubility of Mg hydroxide with the concentration of the salt does not correspond with the corrosion rate-concentration curves. Analyses of the curves have provided additional evidence of the primary preferential hydroxyl ion discharge. Dissolution time curves were also obtained for Mg-Li-Na- and K chloride solutions and the solubility of Mg hydroxide has been measured therein. 10 references. PRK (13)

The Influence of the Electrode Surface on Anodic Processes. O. J. Walker & J. Weiss. *Transactions Faraday Society,* Vol. 31, Aug. 1935, pages 1011-1017. In a recent series of studies on electrical oxidation, Glasstone and Hickling proposed a new general theory for the mechanism of anodic oxidation. They suggested that H_2O_2 was formed as the primary reaction product. This is highly improbable. As H_2O_2 is not formed, it is necessary to account for the addition of salts of Pb, Ag, Mn, Co, etc. bringing about a marked change in the anode process. When passing 450 coulombs at a current density of .25 amps./cm.^{2} between bright Pt electrodes in $CH_3COOK + CH_3COOH$, 1 g. mol./l. each, a definite change in the anode surface took place upon addition of Pb, Mn, Ag and Co acetate to the solution. In explanation it was offered that a distinction must be made between electrodes with high overvoltage and electrodes with low overvoltage. At anodes with high O_2 overvoltage the primary discharge of an anion is favored, whereas at anodes of low overvoltage the OH^- ion is discharged. The resulting OH radicals may then take part in chemical oxidation at the electrode. The effect of adding the metallic salts to the acetate solution, which decreases in the order Pb, Ag > Mn > Cu, Co, Fe, is the formation of oxidized layers on the anode, all of which have a low overvoltage for discharge of OH^-. 25 references. PRK (13)

Corrosion Resistance of Hydronalium, Especially to Seawater (Ueber die Korrosionsfestigkeit von Hydronalium, insbesondere gegen Seewasser) G. Siebel. *Aluminium,* Vol. 17, Nov. 1935, pages 562-567. Due to their resistance to alkalies, the Mg-Al alloys possess an excellent corrosion resistance to seawater which increases with increasing Mg content. The heterogeneous structure of the cast state of high % Mg-Al alloys is practically as seawater-resistant as the homogeneous structure. The kneading alloys of Mg-Al become very temperature-sensitive by cold-deformation which results in severe intercrystalline corrosion. A stable structure can, however, be obtained by heterogeneization below the demixing line. Additions of Zn, Ca, Si, Ti, Cr, strengthen the homogeneous state and render those alloys more resistant to corrosion. Ha (13)

Corrosion of Gas Pipe Line in California. J. C. Albright. *Petroleum Engineer,* Vol. 6, Feb. 1935, pages 36-38. While the H_2S concentration in California gas is extremely small compared to that in some of the gas produced in Texas, corrosion of pipe lines, orifice meter plates, and other pipe line fittings has been great. Practically all the indications of corrosion of pipe lines or fittings found in California gas lines have been where pressures have been high, over 75 lbs./in.^{2} Previous experience had proven that S and O in the presence of water and under pressure were very corrosive. The amount of H_2S and O_2 found in gas varies according to localities from 0.008 to 0.079 grains H_2S /100 ft.^{3} gas and trace to 0.6% O. GTM (13)

Effect of Air Velocity on the Scaling of Iron (Der Einfluss der Luftgeschwindigkeit auf die Verzunderung von Eisen) W. Baukloh & O. Reif. *Metallwirtschaft,* Vol. 14, Dec. 27, 1935, pages 1055-1057. Samples of Armco iron were heated in a quartz tube at 600°, 700° and 800° C. in a stream of air which was pre-heated in another furnace. The velocity of the air was varied from .05 to .7 m./sec. At each temperature the loss in weight due to scaling rose sharply at first with increase in air velocity, then dropped after reaching a maximum, and finally became constant. The maxima and horizontals in terms of weight loss were higher the higher the temperature, and the maxima occurred at higher velocities the higher the temperature. A theoretical explanation is given. CEM (13)

The Atmospheric Corrosion and Tarnishing of Tin. L. Kenworthy. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1331-1345. Tests were carried out on samples in the form of sheet and wire of pure Sn and Sn alloyed with 2.2% Sb and with .2% Cu. Comparison was made with similar samples of Cd, Zn, Ni, 70-30 brass and Cu. Exposures were made indoors, outdoors protected from rain, and outdoors exposed to rain for periods up to about 800 days. Data relative to the change in weight and in tensile strength and in elongation are given in the form of tables and graphs. It was found that in indoor atmospheres Sn and its alloys were attacked less than Cu, Zn or Cd. Pure Sn showed a slight definite superiority over alloyed Sn. The relationship between the weight increment and the time of exposure for Sn in an indoor atmosphere is a linear function except for the first 3 or 4 days. The film formed is probably of a granular nature and not of a continuous protective type. When out-of-doors but protected from the rain, Sn and its alloys were superior to Ni but slightly inferior to Cu. Under these conditions of test the rate of corrosion is closely associated with the deliquescent nature of the corrosion products. Observation showed that Ni formed a more deliquescent corrosion product than Cu and so was corroded more than Cu, but under conditions of complete outdoors exposure without protection from the rain, Ni proved more resistant than Cu. Under these same conditions Sn and its alloys were superior to the comparison materials tested which showed increasing rates of attack in the following order: Ni (least), Cu, brass, Zn and Cd (most). The effect of complete outdoor exposure on the mechanical properties of pure Sn and the 2 Sn alloys was variable. The average value of these 3 materials would appear to indicate that Sn is affected slightly more than Cu and less than Cd. 6 references. PRK (13)

The Corrosion of Tinplate. T. P. Hoar. *Technical Publication of the International Tin Research & Development Council,* Series A, No. 30, 1936, 11 pages. Reprinted from *Proceedings Swansea Technical College Metallurgical Society,* 1936. Consideration is given the corrosion of Sn and of steel, separately and together as tinplate, especially under conditions attained in packing foods in tinned containers. The attack on Sn by dilute organic acids is practically negligible in the absence of air, since H_2 is evolved very slowly from a Sn surface. Exposed steel in tinplate, whether at natural pores or formed through mechanical rupture of the Sn-Fe compound layer, may be protected or the rate of corrosion minimized by the anodic behavior of the Sn under many conditions, as in most canned fruits. The presence of Sn ions in solution also tends to inhibit further attack but these may be removed from solution as insoluble complexes when proteins are present. These proteins act as corrosion inhibitors on steel, however; other constituents, as sulphides, may act as accelerators. Steel composition is also an important factor which must be taken into account. There is some evidence that the presence of Sb or of Bi in Sn aids its resistance to corrosion. Pinholes in tinplate may be substantially reduced by electrodeposition over the hot dipped coating. Lacquering is useful in preventing discoloration of fruits but may increase danger of perforation. BWG (13)

Corrosion of Magnesium and Magnesium Alloys. Hideo Nishimura & Hachie Sawamoto. *Suiyokwai-Shi,* Vol. 8, Dec. 1935, pages 911-922. Corrodibility of Mg and Mg alloys in dilute acidic or NaCl solutions were compared by the measurement of the gases evolved. From the experiments it is concluded that Mn and Zn retard corrosion, but the Al and Cu contents stimulate the corrosion rate of Mg. HN (13)

Protection of Aluminum Alloys. F. C. Pyne & W. L. Fink. *Aviation,* Vol. 35, Feb. 1936, pages 30-33. Discusses testing of Al for corrosion resistance, heat treatment of Al alloys on the market, anodizing process, corrosion inhibitors, spot welding. 3 tables with test results are included in the paper showing (1) atmospheric corrosion of 4 different 14 gage sheets after 1, 2 and 5 years as determined by losses of tensile strength and elongation, (2) alternate immersion tests on same material and (3) effect of 7 different quenching methods on the resistance to corrosion of the 17 ST alloy. WH (13)

The Control of Corrosion in Air-conditioning Equipment by Chemical Methods. C. M. Sterne. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 261-274; *Mechanical World & Engineering Record,* Vol. 48, Oct. 25, 1935, pages 403-404. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 80L/7. WH (13)

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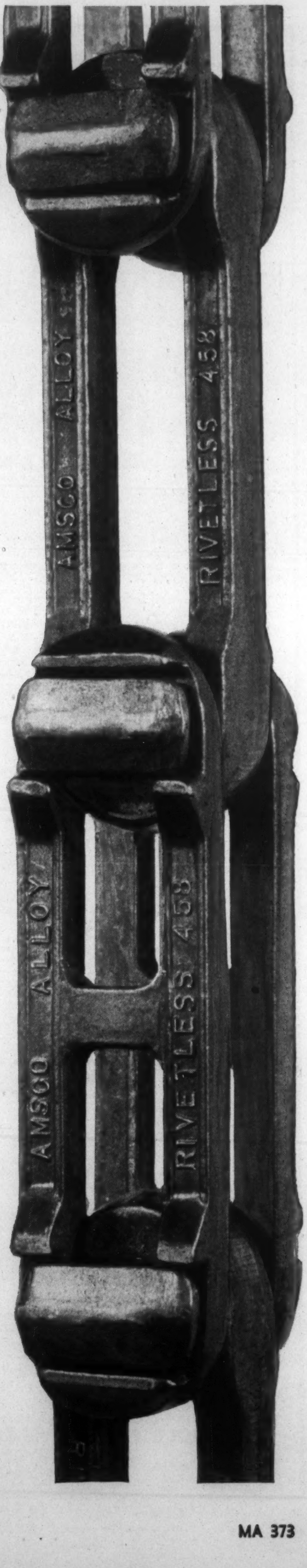

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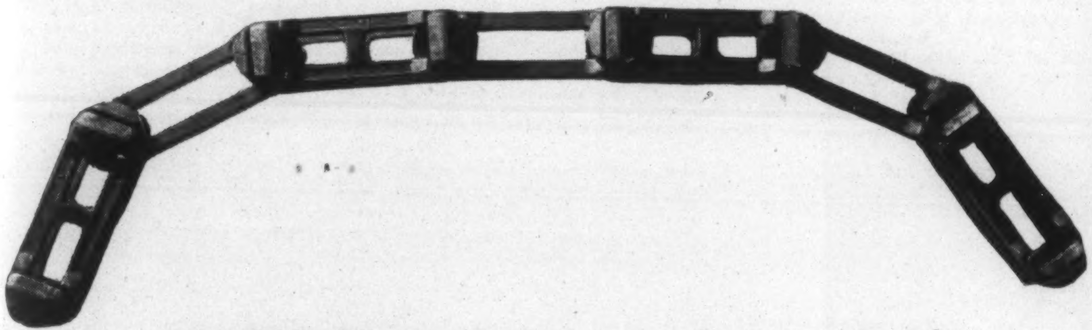

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Corrosion of Metals and Alloys in Apiezon Oil. GUNJI SHINODA. *Proceedings Physico-Mathematical Society of Japan,* Vol. 17, Series III, Sept. 1935, pages 367-368. In English. The corrosive action of apiezon oil on low C-steel, Cu, Al, Sn, Pb, Duralumin, 12% Sn-bronze, 40% Zn-brass, constantan, Ni and Sn-solder was studied at 170°-175° C. Al and its alloys are suitable construction materials for the inner part of a pump and steels are preferable for the pump case. The Sn-solder should not be used in the neighboring parts of the heater. Cu tubes, which are widely used up to the present time, were found to tarnish to reddish-brown resulting in a discoloration of the oil. The surface of Ni and constantan became gray after 1 month. Regarding the weight loss due to corrosion, Sn and Sn-solder were closely followed by Pb. WH (13)

Anodic Passivation. W. J. SHUTT. *Transactions Faraday Society,* Vol. 31, Apr. 1935, pages 636-637. Further discussion of the theory of anodic passivation of Au by Shutt and Walton is given refuting the explanations of their data by Armstrong and Butler. PRK (13)

Passivity of Gold. W. J. MÜLLER & E. LÖW. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1291-1299. Experiments with 5 *N* HCl solution showed that the process of the passivation of Au followed the laws of the theory of passivation by surface layers Au exposed to air becomes coated with an oxide layer which is removed during passivation in concentrated acid. The oxide layer of Au is not destroyed by anodic current in diluted HCl. The anodic passivation remains limited to the pores of the natural oxide layer. The relation between initial current and time of passivation is $(i-i_a)t = \text{const.}$, in accordance with the experimental results of Shutt and Walton and of Armstrong. The differences in the behavior of protected and of freely suspended electrodes are of a quantitative nature only. With the protected electrode passivity will be attained sooner or later. For instance, Fe in H_2SO_4 with an initial current density of 18 milliamps./cm.^{2} becomes passive after 22 hours. With electrodes freely suspended or stirred the time of passivation is much longer and there exists a lower limit of the current below which no passivation occurred. There is probably a difference in the character of the natural oxide layers formed on Au exposed to the air and to the "secondary" layer produced by electrolysis. In 5 *N* acid the "secondary" layer is dissolved to a certain degree even during the passage of the current. The alternative formation and dissolution of the oxide layer leads to regular long period oscillations of the current density. In sufficiently diluted acids (1 *N* and .05 *N*) no dissolution occurs. There is no reason to see in the anodic behavior of Au anomalies from the point of view of the theory of passivation by surface layers. 13 references. PRK (13)

Wear of Cylinder Sliding Faces (Ueber den Verschleiss von Zylinderlaufbahnen) RICHARD KOCH. *Automobiltechnische Zeitschrift,* Vol. 39, Jan. 25, 1936, pages 31-36. The factors affecting the wear of cylinder faces of automobile motors, namely the material, correctness of working methods, lubrication and type of fuel are discussed individually. Mn in the cast Fe increases hardness and reduces wear, Si reduces hardness and increases wear, graphite acts like Si, Cr prevents the disintegration of the structure during normalizing up to 600° C. and increases hardness; Ni has no influence on wear. S in moderate amounts increases wear resistance and rarely gives rise to segregations in the casting. When cooling from 100° C. above the solidification point to solidification with a rate of 500° C./min. a cementite structure is produced, with a rate of 200° C./min. a structure of coarse flaky graphite. The mechanical properties of a good cylinder material of 7.6 sp.gr. at the place of greatest wear in the cylinder should be: 220 kg./mm.^{2} Brinell hardness, 85 kg./mm.^{2} compressive strength, 20 kg./mm.^{2} tensile strength, and 40 kg./mm.^{2} bending strength; hardness alone is not an absolute criterion for wear. If the hardness of the piston rings is greater than that of the cylinder the latter wears more and the cylinder wears less if the same material is used for the piston rings. The best difference in hardness is about 50 Brinell units. Addition of Mo to the cylinder material influences formation of graphite only but not wear. Piston rings centrifugally cast have given good results, a good material contains 3.5% C, 3% graphite, 0.5% bound C, 3% Si, 0.7% Mn, 0.3% P, 0.03% S. The piston itself is preferably made of an Al alloy of 84% Al, 14% Cu, 1.5% Mn, 0.5% magnesia, or of a high percentage Si-Al alloy because of its low heat expansion. Mechanical treatment, rules for assembling, and fuel mixtures are described. Ha (13)

Black Spots on Tin and Tinned Ware. SVEN BRENNERT. *Aluminium & the Non-Ferrous Review,* Vol. 1, Dec. 1935, pages 105-110. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 512R/2. JCC (13)

Influence of Texture on the Chemical Resistance of Metals. C. H. DESCH. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Nov. 2, 1934, page 314. Abstract of lecture before the Institution of Chemical Engineers. See *Metals & Alloys,* Vol. 6, Mar. 1935, page MA 124L/3. MS (13)

Metallic Coatings as Protective Media. S. ROBSON & P. S. LEWIS. *Chemical Trade Journal & Chemical Engineer,* Vol. 96, Mar. 8, 1935, page 168. Abstract of paper read before Bristol Section and Chemical Engineering Group of the Society of Chemical Industry. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 415L/2. MS (13)

The Protection of Magnesium Alloys Against Corrosion. H. SUTTON & L. F. LE BROCQ. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 199-226. Includes discussion. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 34R/7. (13)

The Corrosion of Tin and Its Alloys. I. The Tin-rich Tin-antimony-copper Alloys. T. P. HOAR. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 135-147. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 540. (13)

The Effect of Five Years' Atmospheric Exposure on the Breaking Load and the Electrical Resistance of Non-ferrous Wires. J. C. HUDSON. *Journal Institute of Metals,* Vol. 56, No. 1, 1935, pages 91-102. Includes discussion. See *Metals & Alloys,* Vol. 6, June 1935, page MA 252L/9. (13)

A Reflectivity Method for Measuring the Tarnishing of Highly-polished Metals. L. KENWORTHY & J. M. WALDRAM. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 247-263. Includes discussion. See *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 540. (13)

14. APPLICATION OF METALS AND ALLOYS

Metallurgical Trends of Chemical Engineering Interest. Clyde E. Williams. *Chemical & Metallurgical Engineering,* Vol. 43, Jan. 1936, pages 17-19. Recent developments in ferrous and nonferrous alloys, in metals for high temperature service and in welding are discussed. PRK (14)

Food-Processing Plant. N. D. Sylvester. *Chemical Trade Journal & Chemical Engineer,* Vol. 96, Jan. 25, 1935, page 57. Abstract of paper read before the Birmingham & Midland Section of the Society of Chemical Industry. See "Metals in the Food industry," *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 340L/1. MS (14)

Materials Approved in England for the Construction of Diesel Engines (In England bewährte Werkstoffe für den Dieselmaschinenbau) *Automobiltechnische Zeitschrift,* Vol. 39, Jan. 10, 1936, pages 19-20. The tendency to use only the best grades of materials in order to economize in weight and space is commented on and a list compiled of materials recommended for the engine frame, the motor, valves, piston and piston rods, fuel transmission, and other parts. Ha (14)

Competition Between Most Suitable Materials for the Design of Instruments (Der Wettstreit um die zweckmässigsten Werkstoffe der Apparatebaues) B. Block. *Chemische Apparatur,* Vol. 23, Jan. 10, 1936, pages 1-4. The selection and availability of material used in the construction of instruments and apparatus, from the standpoint of mechanical strength, safety and endurance is discussed. A table shows the mechanical, physical, thermal, physiological and corrosive properties of metals and non-metals and behavior and mode of application. Ha (14)

The Role of Metals in the Railway Industry. E. J. W. Ragsdale. *Railway Age,* Vol. 99, July 20, 1935, pages 87-89. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 84L/4. CBJ (14)

A.S.T.M. Reviews Constructional Metals. *Iron Age,* Vol. 137, Mar. 12, 1936, pages 55, 81-88. Abstract discussion of papers read at regional meeting of American Society for Testing Materials at Pittsburgh. High strength constructional metals and alloys are discussed. VSP (14)

Metals and Alloys in Locomotive Construction. V. Harbord. *Journal Institution of Locomotive Engineers,* Vol. 26, Jan.-Feb. 1936, pages 46-77. Includes discussion. With modern high-strength alloys, stress concentrations from tool marks, sharp corners, or even date stamps may lead to failure. With mild steel, embrittlement may occur after low-temperature heating (200° C.) if stresses remain after fabrication, as by use of too high a pressure in riveting. Examples of such failures are illustrated. JCC (14)

■ 14a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Aluminum Bumpers for Automobiles (Aluminium-Stossstangen bei Personenwagen) W. Schnorrenberg. *Aluminium,* Vol. 18, Feb. 1936, pages 59-60. Successful experiments with Al bumpers of 6 x 50 mm. bars are reported. The whole energy of the car was elastically destroyed in the moment of impact without the passengers being injured or severely shaken or the bumpers breaking, while steel bumpers transmit the impact almost entirely to the passengers. Ha (14a)

Aluminum Alloy Rods for Locomotives—Continental and American Experiences. Brian Reed. *Metal Industry,* London, Vol. 47, Oct. 4, 1935, pages 339-340. The possible use of light alloys for moving parts of locomotives was studied academically for a number of years but the limited space available prevented practical experimentation. The author describes the results of experiments on 2 railroads. A set of duralumin rods were fitted on an engine of the French Eastern Railway in 1931. The rods were designed to replace steel units without any modification and weighed 20% less than the rods replaced. The material was 94% Al, 4% Cu, 0.5% Mn, and 0.5% Mg. They were normalized and aged. The physical properties of the material are given. After running 41,000 miles without giving trouble they were not replaced when damaged in an accident to the locomotive. In America considerable experience was obtained by the Alton & Southern Railroad which has had several installations on 145-ton 10-coupled locomotives for several years. The metal used was 25ST of the approx. analysis 94% Al, 4.4% Cu, 0.75% Mn, and 0.8% Si. The physical properties of the alloy and the weights saved by these installations are given. Examination of failed bars, similar in shape and fittings to the steel bars replaced, showed unequal stress distribution so the bars were redesigned. The new bars show a weight saving of 40% and all lubrication holes and ducts are now located at points of proved low stresses. HBG (14a)

Importance of the Light Metal Cylinder Head for Automobiles (Ueber die Bedeutung des Leichtmetall-Zylinderkopfes in der Kraftfahrt) O. Summa. *Aluminium,* Vol. 18, Feb. 1936, pages 51-53. Experiment and practical application have shown the superiority of the Al-cylinder head in automobile motors over cast Fe; while the h.p./l. cylinder volume was 21.03-21.34 for cast Fe, it is 23.51-24.13 for Al. The fuel consumption is 326 g./brake h.p. in Fe against 293 for Al. The reduction in weight for the engine is about 5%, for the whole car 1%. Correct methods of molding, casting and assembling are described. Ha (14a)

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Annual Report of Public Printer, 1935. U. S. Government Printing Office, Washington, D. C. 46 pages. The Printing Office adjusts to composition 9 million pounds of type metal annually. A universal type casting metal was adopted, replacing 4 different formulas previously used for different type of machines. It contains 6% Sn, 12% Sb, 82% Pb. Electrotype backing metal has been reduced in Sn from 4% to 3.5%. The rest is 3.5% Sb, 93% Pb. Stereotype metal has been increased in Sn and Sb content, to 9% Sn, 14% Sb, 87% Pb, to give a better wearing type. Stereotypes can now be Cr plated without first flashing with Cu. It is interesting to trace, in the recapitulation of costs, those ascribable to New Deal agencies. Beside the direct costs, the indirect ones mount up too. A new building project, to cost about 6 millions, for the Printing Office, was inaugurated, the act stating that employment is to be "without reference to civil service laws." HWG (14a)

Aluminium Packing in the Canning Industry. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 17-18. Al packing is particularly suitable for herrings in oil and has also been used in Norway for brisling, kippers, crabs, shrimp, and "fresh-fish." Internal surface protection is not needed for these products. In 1934-35, 8,000,000 boxes of herring were packed in Al. JCC (14a)

Aluminum in the Textile Industry. H. J. Fahrney. *American Silk & Rayon Journal,* Vol. 15, Feb. 1936, pages 33-34, 53. The numerous applications of Al in textile machinery parts are enumerated. It is very widely used in the manufacture of viscose rayon. WHB (14a)

Aluminum Wire, Its Manufacture and Uses. R. T. Griebling. *Wire & Wire Products,* Vol. 11, Feb. 1936, pages 69-71, 106. Development of the Al wire industry is briefly outlined, the properties of Al and Al-Mn, Al-Mg, Al-Cu-Mg, Al-Cu-Mn-Mg, Al-Si-Mg and Al-Mg-Cr alloys are briefly described and some applications illustrated. Ha (14a)

Aluminium and Its Alloys. J. Hinde. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Oct. 5, 1934, page 237. Discusses their use in construction of chemical equipment. Pure Al resists action of nitric and acetic acids at most concentrations and is used for storage and transport tanks for these acids. It is used for crystallizing pans for citric and tartaric acids. It is satisfactory for use with most fatty acids and has found many applications in the edible oil, brewery, dairy, food, and paint industries. Oxyacetylene and oxyhydrogen processes are best methods of fabrication. Mixture of NaCl, KCl, a fluoride, LiCl, and an acid sulphate makes a satisfactory flux, which must be washed away when welding is completed. For pressure plant, where higher strengths are required, Al alloys containing Mn or Mg are more satisfactory. They have good corrosion resistance. Care must be exercised in using Al and its alloys for high-temperature reaction equipment. MS (14a)

Recent Developments in Light Alloy Pistons. H. J. Mabrey. *Journal Institution of Production Engineers,* Vol. 14, Sept. 1935, pages 495-506. With discussion. The addition of Si to Al alloys reduces their coefficient of linear expansion, and thus increases their "suitability" for piston manufacture. "Suitability" is expressed as thermal conductivity divided by the product of density and coefficient of linear expansion. "Suitability" of cast Fe is 201; of Al alloy with 18% Si, 3% Cu is 897. Heat treatment to increase Brinell hardness is thought unnecessary, since hardness falls in service and anyway is no measure of performance of piston material under working conditions. JCC (14a)

Aluminum as a Native and Substitute Material. The Recent Developments in Its Use (Aluminium als Heimstoff und Austauschwerkstoff. Die neuere Entwicklung seiner Verwendung) Hans Schmitt. *Zeitschrift für Metallkunde,* Vol. 28, Jan. 1936, pages 17-19. A general discussion of modern uses of Al in transportation, in the electrical industry and in static structures. The new uses of Al created by developments in the technique of welding, anodic coating and plating of Al are also enumerated. No specific information is given. FNR (14a)

Old and New Uses of Lead. Felix Edgar Wormser. *Mining Congress Journal,* Vol. 22, Feb. 1936, pages 18-21. Major outlets of Pb are in battery plates, pigments, cable manufacture, and building industries. Among interesting new applications of Pb are in high Pb bearing metals containing Cu; Pb-Ca alloys of twice the tensile strength of common Pb, used in telephone cables; Pb with 0.06% Te, which has high resistance to H_2SO_4; Pb-Sb-Sn and Pb-Sn-Cd alloys of high tensile strength used in pipe manufacture. Pb is also used as anti vibration material in foundations for large buildings and heavy machinery; as a lubricant in drawing steel wire through dies; and in lubricants and greases subject to extra high pressures. Information on uses of historical interest is also given. BHS (14a)

Aluminum in the Transportation Industry. A. H. Woolen. *Proceedings Canadian Railway Club,* Vol. 25, Jan. 13, 1936, pages 30-47. The use of Al and Al alloys in recent applications to railway equipment and airplanes is described. Ha (14a)

50 Years of New Product Development. Francis C. Frary & Junius D. Edwards. *Chemical & Metallurgical Engineering,* Vol. 43, Feb. 1936, pages 64-67. Mention is made of the significant developments during the 50 years in which Al emerged from a jewelry store metal into the position of the fifth metal in point of tonnage. PRK (14a)

Alloys of Aluminum. P. V. Faragher. *Product Engineering,* Vol. 7, Feb. 1936, pages 62-66; Apr. 1936, pages 137-140. Casting alloys of Al, their workability, forming operations, riveting, heat treatment and annealing are discussed; examples for the recently applied impact extrusion process are described. Range of properties of the most used Al alloys, composition and manner of working are tabulated. Ha (14a)

Superiorities of Lead Calcium Alloys for Storage Battery Construction. H. E. Haring, U. B. Thomas, E. E. Schumacher & G. S. Phipps. *Bell System Technical Journal,* Vol. 14, Oct. 1935, pages 699-700. Brief resume of material covered in previous papers. Pb containing 0.10% Ca has a tensile strength of 8000 lbs./in.^{2}, an electrical conductivity 20% greater than 9% Sb alloy, and when used in storage cells gives plates losing only 4 to 5% of their charge per month as compared to 20 to 25% for Pb-Sb alloys. HFK (14a)

All Industry Benefits by Adoption of New Alloys and Better Methods. J. J. Nelson. *Steel,* Vol. 98, Feb. 10, 1936, page 57. Points out importance of keeping abreast of new developments in alloys by account of manufacturer who made considerable saving by substituting lighter and cheaper alloy, which would give as good service, for P-bronze mixture originally intended. Bronze cost 13.95c/lb. just for the contained metals, whereas substitute cost on the same basis, about 9c/lb. Originally estimated weight of 145,000 lbs. was reduced to 133,000 lbs. with the substitute. MS (14a)

New Markets and Uses of Zinc. Russell B. Paul. *Mining Congress Journal,* Vol. 22, Feb. 1936, pages 24-25. Galvanizing is the largest consumer of Zn, taking about 42% of the total production. Discusses use of high-grade Zn (99.99% +) in die casting. Automobile industry is the largest consumer of die cast Zn. High purity metal is also becoming more and more important in galvanizing. More exacting demands have also led to extensive use of high-grade Zn in brass manufacture. Lately an electrothermic process has been developed for the manufacture of Zn oxide. Powdered Zn is a valuable pigment for rust protection and its use is increasing. BHS (14a)

Copper-Nickel (70:30) Alloy. Mason S. Noyes. *Journal American Society of Naval Engineers,* Vol. 48, Feb. 1936, pages 1-18. The reason for the Navy's choice of 70:30 (Cu:Ni) for condenser tubes and other uses for sea water corrosion resistance are detailed in form of results obtained from tests on a number of non-ferrous materials. The corrosion tests included rapid rotation in brackish sea water, slow movement in electrolytic cell containing brackish water, and impingement tests for a jet of brackish sea water. The second test reveals which metal of the cell is anodic since the potential of the cell is measured. A great deal of information on the 70:30 alloy has been culled from the literature showing its good corrosion resistance to salt water, and methods of soldering, bending, etc. are given. The 70:30 alloy is intended to replace for salt water lines the former use of Cu tubing soldered and Sn lined on the inside. WB (14a)

Uses of Copper Tubing in Central Heating Plants (L'Emploi des Tuyaux en Cuivre dans les Installations de Chauffage central) A. Chaplet. *Cuivre et Laiton,* Vol. 9, Mar. 15, 1936, pages 107-108. Advantages of Cu pipes over steel pipes in heating plants are the lower friction coefficient of the liquid on the walls of the tube, lower heat losses by radiation and convection and less stored heat. Methods of installation are briefly described. Ha (14a)

New Uses for Copper. B. B. Caddle. *Mining Congress Journal,* Vol. 22, Feb. 1936, pages 21-23. Mechanical refrigeration offers an important new outlet for Cu, taking about 25,000 tons in 1935. Air conditioning also important consumer. A large tonnage of the metal is now going into house construction; railroads, and automobile manufacturers are also taking large tonnages at present. Recently an electrolytic sheet Cu has been put on the market. This material is excellent for damp-proofing, for built-up roofing, and for interior decoration. BHS (14a)

■ 14b. Ferrous ■

M. GENSAMER, SECTION EDITOR

Wear Resisting Steel Is Used in Concrete Mixer of New Design. *Steel,* Vol. 97, Nov. 11, 1935, page 42. Mixer drum is made of a steel shell and flanged heads welded together. Shell and mixing blades are of normalized, wear-resisting steel plate containing 0.40-0.50% C. Drum tires are of rolled steel welded to shell. Drive gear and pinion are Ni-Cr semisteel castings. Mixer frame is of structural shapes completely welded. Drum rollers are car-wheel Fe, chilled on face and flanges. They are equipped with 2 bearings each and supported in alloy steel shafts. Drive-shaft is of S.A.E. 1035 steel. MS (14b)

Large Uses of Steel in Small Ways. No. 299. Ground Clamps. *Steel,* Vol. 97, Nov. 11, 1935, page 50. About 60 tons of strip steel and 10 tons of $\frac{3}{16}$" screw-rods are consumed annually in the manufacture of radio ground clamps. Parts are Cd plated. Outlines fabricating operations. MS (14b)

Story of the House That Builds Jacks. W. G. Gude. *Steel,* Vol. 97, Nov. 18, 1935, pages 35-36. Outlines methods of Walker Mfg. Co., Racine, Wis., in manufacturing automobile jacks. Standard and base of pressed steel jack for light cars are stamped from steel strip. Gear and pinion are malleable Fe. Outer screw of double screw is made of hot-rolled S.A.E. 1112 Bessemer screw-stock. Inner screw is turned from high-C steel. Screws used on larger jacks are heat treated and hardened. Ball-bearing races are stamped from hot-rolled, pickled, and oiled strips. Cap on top of screw is stamped from hot-rolled steel and is carburized to resist wear. Caps on heavier jacks are drop forged. Base and standard of jacks with a capacity of more than 1 ton are of malleable Fe. Oil reservoir of hydraulic jacks is of welded tubing, while pressure cylinder is unannealed seamless tubing. Cd plating is used to prevent seizure of piston. Service jacks are largely malleable castings, with some drop forged and rolled steel. MS (14b)

Fit Product to Season, Says Sheet Metal Fabricator. A. H. Allen. *Steel,* Vol. 97, Sept. 9, 1935, pages 36-38. Describes fabrication, finishing, and assembly of beverage coolers and refrigerators by the Lima Metal Products Inc., Lima, Ohio. Cold rolled sheet steel, vitreous enamel stock, and galvannealed stock are used. Some parts are spot welded. Exterior is given a crinkle finish by spraying a mixture of china-wood oil, asphaltum, and varnish gums, followed by baking at 350° F. in a continuous oil-fired oven. Exterior hardware is Cr plated. Domestic refrigerator cabinets are finished in synthetic enamel. Forming dies are largely of Ni cast-Fe or meehanite, with oil-hardening tool-steel inserts where excessive wear is encountered. MS (14b)

The Story of the Ford Cast Crankshaft. Edwin F. Cone. *Metals & Alloys,* Vol. 6, Oct. 1935, pages 259-263. Cast crankshafts have been used by Ford for 3 years and following composition is used at present C 1.35-1.60%, Mn 0.60-0.80%, Si 0.85-1.10%, Cu 1.50-2.00%, Cr 0.40-0.50%, P 0.10% max., S 0.06% max. Pouring is done in dry sand molds containing 4 shafts. Castings and finished shafts both weigh less than rough forgings and shafts finished from them. WLC (14b)

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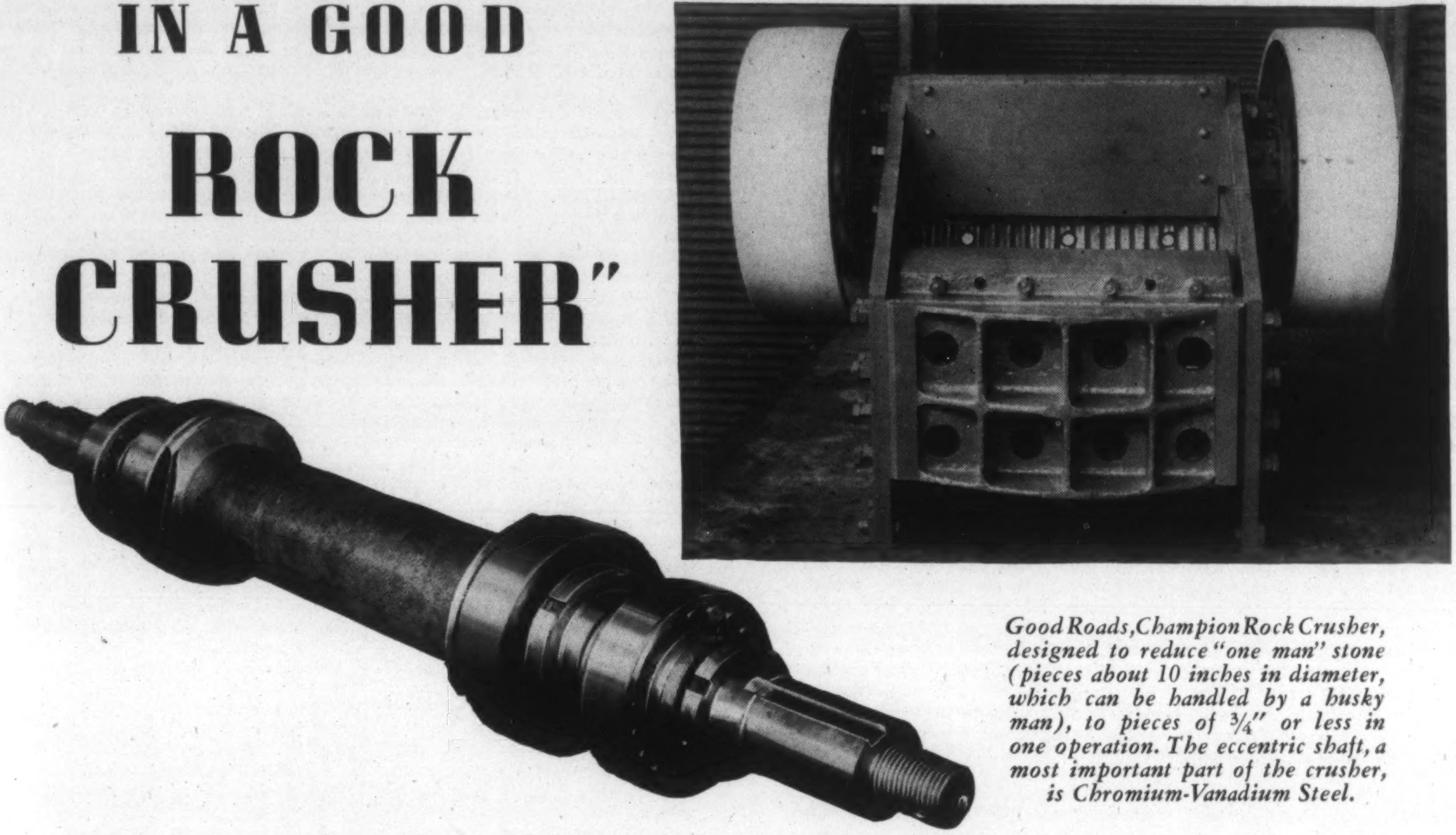

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Forging Logging Tools. J. B. Nealey. *Heat Treating & Forging*, Vol. 21, Dec. 1935, pages 567-568. Describes procedure and equipment of the Dixie Logging Tool Co., Chattanooga, Tenn. Tools are made from C steels and tool-steels. Gas-fired forging furnaces and mechanical hammers with accurately cut dies are used. MS (14b)

Slab Yard Cranes Are Built with Hydraulic Brakes. *Steel*, Vol. 97, Sept. 23, 1935, pages 143, 149. Describes cranes, of arc-welded steel construction, which serve slab yard of a 76" hot strip mill in the Youngstown district. MS (14b)

Alloy Steels Used in Oil Refinery Distillation and Cracking Equipment. J. C. Morrell, L. A. Mekler & Gustav Egloff. *Oil & Gas Journal*, Vol. 34, June 20, 1935, pages 50, 52, 62, 64. A comprehensive and valuable review of alloy steels used in oil distillation and cracking equipment. VVK (14b)

Stainless Steel in the Milk Industry. J. A. McWilliam. *Milk Industry*, Vol. 15, May 1935, page 75. Steel containing 18% Cr and 8% Ni is the most satisfactory metal for tanks, vats, coils, and pipes, and is replacing other materials in all types of milk containers. A historical and descriptive discussion. GPS (14b)

Nickel-Bearing Alloys in the Production and Refining of Petroleum. Byron B. Morton. *Mining & Metallurgy*, Vol. 16, Oct. 1935, pages 411-414. A general review of the use of Ni cast Fe, Ni-resist, Monel metal and Cr-Ni alloys in the production and refining of petroleum. VSP (14b)

Manufacturing Airplane Struts. F. L. Prentiss. *Iron Age*, Vol. 136, Dec. 12, 1935, pages 20-24, 94. Describes the construction of shock absorbing struts by the Cleveland Pneumatic Tool Co. Strut parts are made of 4130 x Cr-Mo steel made in electric furnace. Composition of steel is: 0.25-0.35% C; 0.40-0.60% Mn; 0.040% max. P; 0.80-1.10% Cr; 0.15-0.25% Mo; and 0.15% min. Si. Stock is received annealed having tensile strength of 90,000 lb./in.^{2}, Brinell hardness of 177-180 and C scale Rockwell hardness of 14-15. Tensile strength is increased by subsequent heat treatment to 150,000-180,000 lb./in.^{2}, Brinell hardness 377-380 and C scale Rockwell 45-46. Parts are atomic H_2 welded, machined and plated. VSP (14b)

Application of Alloy Steels. H. W. McQuaid. *Canadian Chemistry & Metallurgy*, Vol. 20, Jan. 1936, pages 19-20; *Heat Treating & Forging*, Vol. 22, Jan. 1936, pages 19-24. Address delivered before the American Institute, Dec. 15, 1935. Deals with effect of alloying elements on hardening, Mn as an alloy, a comparison of alloy- vs. C-steels for gears, and a discussion on the strength of the steels at high temperatures. WHB + MS (14b)

Care, Inspection and Maintenance of Lifting Equipment. A. Taylor. *Mechanical Handling*, Vol. 22, Mar. 1935, pages 67-71, 131-136. See "Crane Ropes, Chains and Hooks," *Metals & Alloys*, Vol. 6, Sept. 1935, page MA 377L/6. JCC (14b)

Wire and Cable in Aircraft Manufacture. R. Rummell. *Wire & Wire Products*, Vol. 10, Dec. 1935, pages 560-577, 588-589. A full report is given by the Research Committee to the A.S.M.E. on the attempted correlation between bending and torsion fatigue tests made on tempered Swedish valve spring wire. 35 references. Ha (14b)

The Era of Stainless Steel. L. M. Angus-Butterworth. *Sheet Metal Industries*, Vol. 9, Nov. 1935, pages 699-700. A general discussion of the development of stainless steels and their increasing use. AWM (14b)

Manufacture and Finish of Golf Shafts. R. P. Brown. *Iron Age*, Vol. 136, Oct. 17, 1935, pages 34A-34B, 70-71. Describes manufacture and finish of steel golf shafts by the American Fork & Hoe Co. Cold drawn tube stock is cut to length, fully annealed and quenched in H_2O. Quenching consists of 3 stages, the last being clear fresh H_2O. Following this tubes are cut to length and Cu flashed in $CuSO_4.5H_2O$ solution prior to drawing. Cold draw benches reduce tubes to desired thickness. On leaving stepping press shafts are tempered. After testing the shafts are Cu or Cr plated. VSP (14b)

Nitricastiron Cylinder Sleeves. A. T. Colwell. *Iron Age*, Vol. 136, Dec. 19, 1935, pages 31-33. Describes nitricastiron cylinder sleeves for bus and truck motors. Tests indicate that nitricastiron sleeves increase mileage to a total of 300,000 to 400,000 miles without any service being necessary. Nitricastiron is a special grade of Fe which is nitrided on the bore surface. Hardness will be from 800 to 1000 Brinell for a depth of 0.004" to 0.006". Analysis is as follows: Total C 2.93%; graphite C 2.31%; combined C 0.62%; P 0.058%; S 0.029%; Mn 0.76%; Si 2.69%; Cr 1.28%; V 0.16%; Mo 0.24%; and Al 1.01%. Cylinder sleeve castings are cast centrifugally. Growth during nitriding is allowed for, which may be as high as 0.001". VSP (14b)

Recent Developments in Manufacture of Steels for Oil Equipment. Gordon F. Hess. *Oil & Gas Journal*, Vol. 34, Sept. 19, 1935, page 46. General discussion of control operations incidental to the manufacture of steels for oil equipment. VVK (14b)

Electrical-Heating, Electrical-Resistance and Electric-Furnace Alloys. Report of Committee B-4. Dean Harvey, Chairman. *Proceedings American Society for Testing Materials*, Vol. 35, Part I, 1935, pages 176-178. Recommendations affecting standards and progress report. VVK (14b)

Prefabricated Houses for Low-Price Field. *Steel*, Vol. 98, Feb. 3, 1936, page 46. Describes house developed by General Houses, Inc., Chicago, designed to sell at $2500-$4900, erected and equipped. Frame is of Cu-bearing steel beams and columns. Exterior walls are of asbestos-cement and plywood panels with Al foil insulation. Interior partitions are made of plywood panels and Cu-bearing steel studs. Roof consists of panels of galvanized Cu-bearing steel with joints sealed with steel flashing. Steel is used also for interior trim, door and window frames, and screens. MS (14b)

Speed and Rowboats Are Built of Steel Sheets. *Steel*, Vol. 98, Jan. 13, 1936, pages 30-31. Describes design, and fabrication of boats developed by Gil-Boat Co., Holland, Mich. MS (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Mineral Chemistry. Radioelements, Rare Gases, General Study of Alloys (Traite de Chimie Minerale. Vol. XII. Radioelements—Gaz rares. Etude generale des alliages) Edited by Paul Pascal. Masson et Cie., Paris, 1934. Cloth, 6¾ x 10 inches, 856 pages. Price 180 Fr.

The book under discussion has been written by different authors, each a recognized specialist in his selected field; a method of book writing which is the only one possible in our diversified and enormous field of science.

The first hundred pages or so of this book give rise to the most optimistic expectations. These pages are devoted to radioelements, are expertly written by M. Curie and J. Escher-Desrivieres, and contain much interesting material, perhaps not new to the expert physicist and chemist but indeed most ably summarized for the attention of the interested scientific reader. A short bibliography, quite exhaustive, is appended. Unfortunately this chapter ends with developments up to the year 1931—usual and unfortunately unavoidable shortcoming of any monumental volume.

The chapter on rare gases that follows has an excellent bibliography—its best point. Surely a subject as important and as little known to general scientific readers deserves a more full treatment. Books on phase rule and its application already written (for example, the book by Masing or Marsh) present a more comprehensive study of this subject than the chapter by Portevin written for this book. Prof. Portevin adopted a commendable and rather unusual—at least for English writers—course; namely, that of introducing and discussing the question and matter of diffusion (both liquid-solid and solid-solid) in its proper place, right after the presentation of the principle of solid solutions and laws governing the formation of the latter.

The presentation of the subject is accomplished without recourse to thermodynamics—again a commendable feature; I hasten to add that this is the personal view of the reviewer. As a consequence the average metallurgist will enjoy this chapter and profit by its careful study without experiencing the feeling of self contempt for not being chummy with free energies and entropies. It really is a good chapter, and it would have been made even better if it contained illustrations so desirable in such sub-chapters as the one on segregation and liquation.

Since the year 1927, Volume II of International Critical Tables has been a much consulted book; it was, to the best of the reviewer's knowledge, the only publication in which various metallic systems were summarized and systematized. Personally, I feel somewhat guilty in pushing aside this useful volume, but it must relinquish its place to Volume XII of "Trait de Chimie Minerale," the book under review. The latter contains infinitely more systems (diagrams) carefully arranged; as a summary it is an excellent one. However, as a source of reliable statements it varies from one sub-chapter to another. Particularly good, carefully arranged, and critically surveyed are sub-chapters on copper and antimony. (Imagine a whole sub-chapter devoted to antimony!) Equally good is the sub-chapter on aluminum, containing many corrected diagrams (in comparison with Critical Tables) such as aluminum-zinc or new ones such as aluminum-calcium.

From reading the sub-chapter on iron alloys one might suspect that ferrous metallurgy remains in a state of stagnation. Granting the obvious and enormous difficulties encountered in publishing a book of this sort (it is humanly impossible to keep up to date unless we stop research for two or three years!), yet there are certain things which must be incorporated if they appear in press prior to final publication of the book. To talk of iron-carbon alloys in old terms and disregard the study of rates of reaction is unpardonable.

Inclusion of incomplete or incorrect diagrams for iron-nitrogen, iron-nickel, iron-manganese and other alloys is regrettable. Perhaps a supplement or appendix to this otherwise valuable book would be possible.

A minor criticism: Is it not time that we decided on universal chemical symbols? Even those who read French well enough to enjoy this treatise may be baffled by Glucinium and by the symbol Tu instead of W as is used elsewhere for Tungsten (Wolfram).

This book should be in every reference library, and if one can find somewhere enough francs (180 francs is the price of the book) to pay for this volume, even though it may sound high, by all means pay it. V. N. Krivobok (15) -B-

Textbook of Physical Chemistry (Lehrbuch der physikalischen Chemie) Vol. 5, Part 2. Karl Jellinek. Ferdinand Enke Verlag, Stuttgart, 1935. Paper 6½ x 10 inches, pages 289-576. Price 27 RM.

This part covers the structure of atom shells and cores. Various ideas as to atomic structure, protons, neutrons, positrons, etc. are collected into convenient form, with large doses of mathematics, for those who wish to assimilate them. The last few pages deal with stereochemistry, optical activity, etc. along classical lines of organic chemistry, and this is apparently to be carried farther in the next part.

The metallurgist's interest in the subjects dealt with is usually rather indirect. H. W. Gillett (15) -B-

Transactions American Institute of Mining & Metallurgical Engineers, Vol. 117, Institute of Metals Division. Published by the Institute, New York, 1935. Cloth, 6¼ x 9¼ inches, 418 pages.

While advance copies of most of the papers in the Transactions have been available, it is always of interest to study the bound volume, not only for the discussions, but also to get a picture of what the non-ferrous metallurgists are dealing with. Besides the Division lecture on Gases in Metals by Edwards of Swansea, the volume contains 22 other articles.

Several deal with structure as revealed by X-ray data. Several others deal with equilibria in such systems as Mo-C, Co-O, Cu-Sn-Be, Cd-Sb. A few deal with precipitation hardening phenomena, one being a very important article on Al-Cu-Ni. Another noteworthy article sets forth the thermal and electrical conductivities of Cu alloys. A new tool, the polarization microscope and the application of another, spectrographic analysis, to die castings, are described. Zinc, aluminum and brass die castings are dealt with. Casting properties of metal silvers, properties of Pt metals, and discussion of welded pressure vessels and of oil-production equipment give a practical tone. With a few exceptions the high-brow articles come toward the front and the more practical ones toward the back. This may mean that the Institute feels that its best foot is a high-brow one, if you don't mind unorthodox physiology, or that the writers on theoretical phases got their papers in first.

Anyhow, there is much in the volume that is of direct practical application. H. W. Gillett (15) -B-

Handbook of Chemistry and Physics. 20th Edition. Chas. D. Hodgman, Editor-in-chief. Chemical Rubber Publishing Co., Cleveland, Ohio, 1935. Fabrikoid, 4½ x 6¾ inches, 1951 pages. Price $6.00. The 20th edition of this handbook shows an increase of 18 pages over the last edition. The new and revised tables in this edition are: Physical Constants of Organic (8988) Compounds; Formula Index of Organic Compounds; Pronunciation of Chemical Words; Rules for Naming Organic Compounds; Prefix Names of Organic Radicals; Properties of Amino Acids; X-ray Spectra; Magneto-Optic Rotation; Colorimetry; and Photometry. The X-ray spectra data were revised by Prof. J. M. Cork, University of Michigan to conform to the results of recent determinations. Richard Rimbach (15) -B-

Processes for the Volatilization of Metals with Special Reference to the Manufacture of Zinc Oxide (Die Metallverflüchtigungsverfahren mit besonderer Berücksichtigung der Herstellung von Zinkoxyd). Otto Barth. Verlag von Wilhelm Knapp, Halle (Saale), 1935. Paper, 6⅞ x 9½ inches, 234 pages. Price 15.50 RM.

This book is No. 4 of a series of "Monographs of Metallurgical Practices." Its emphasis is placed on the manufacture of Zn oxide by means of volatilization. The volatilization of other metals, however, is also discussed briefly.

The term "volatilization processes" as used in this book comprises all those processes in which metals or metallic compounds are vaporized from metallic or nonmetallic raw materials to be then recovered in the form of metallic compounds. The emphasis, however, is always placed on the vaporization stage and not on the recovery or the collection of the reaction product.

To mention an example, the book deals for instance with the processes for the volatilization of Zn from a low grade ore, for the purpose of concentrating it in the form of Zn oxide. A discussion of the working of complex ores is also included insofar as it offers a means of separation and a supplement to flotation.

In general, this book is well written and contains a mass of detailed technical data of considerable value to the practical man. Some of the tables, however, are not as clear as might be desirable. Frequently, the meaning of column headings, figures, etc., can be ascertained only through careful study of several paragraphs preceding or following the table. Precise titles and accurate column headings would add considerably to the value of the book as a reference or handbook for the practical metallurgist.

In order to give the reader a better idea of the scope of this book, the main chapter headings are given below.

I—The relation of the volatility of metals and metallic compounds to vapor pressure, temperature, surface area and time.

II—The thermic data of the most important volatile metals and metallic compounds, including arsenic.

III—The metallurgical reactions taking place in volatilization processes.

IV—The raw materials.

V—The volatilization processes.

VI—The manufacture of paint oxide.

VII—The collection of the oxides.

VIII—The properties and testing of Zn oxides.

IX—The evaluation of Zn oxide and Zn white.

X—The manufacturers of Zn oxide and Zn white.

XI—Statistical data.

XII—The patents relating to the volatilization of metals issued in Germany since 1920.

The chapter on paint oxides, their properties and testing methods, is of course applicable primarily to German products and practices but will prove of considerable interest to the American metallurgist and Zn oxide manufacturer.

The appendices listing the manufacturers of Zn oxide, giving statistics on the production, exports, imports, and prices of Zn, Pb and Sn, and reviewing all patents dealing with the volatilization of metals issued in Germany since 1920 are not the least important and useful parts of this book.

Style and language of this book are a pleasant surprise to the foreigner who has had barely enough technical German to pass a college examination. Although grammatical constructions and almost endless sentences so characteristic of technical German are not entirely absent from this book, they are not nearly as frequent as in most German technical or scientific literature. Americans therefore should have little or no difficulty in finding their way through this book.

A. C. Elm (15) -B-

The Way of Iron (Der Weg des Eisens) Fritz Toussaint. Verlag Stahleisen. Düsseldorf, 1935. Paper 8¼ x 11¾ inches, 56 pages. Price 0.90 RM. A condensed description of the production of iron and steel from the ore to the finished product. The book was prepared for those who are not familiar with the manufacture and working of iron and steel. The book is profusely illustrated.

Richard Rimbach (15) -B-

Journal of the Institute of Metals, Vol. 57, No. 2. Institute of Metals, London, 1935. Cloth, 5¾ x 8½ inches, 311 pages.

In reviewing bound volumes of transactions of technical societies, we are often moved to comment on the value of the discussions, which make the final volumes so much more useful than the preprints. This is supremely the case in the instance at hand. Brownsdon's lecture on "Metal Melting, Its Effect on Quality," is followed by over 20 pages of discussion which deals with such topics as filtration of molten metals, use of scrap, solubility of impurities, vacuum melting, hydrogen atmospheres, gas solubility, hydrogen unsoundness, permeability of crucibles to gases, reactions with refractories, deoxidizers, fluxes, etc., all in relation to non-ferrous melting, that are valuable and thought-provoking. Cook's paper on metal losses in melting brass is accompanied by 10 pages of discussion on fluxes, charcoal and coal covers, order of charging, etc. in electric and crucible furnaces.

Some of the other papers on porosity of bronze ingots, properties of bronzes, straining of Pb, stress distribution in flexure of Pb, age-hardening in Cu-Ni-Si alloys, production of powdered solder-like alloys, failure of a gold fuse link in a Ni Cr resistor, corrosion and protection of Mg, and a few X-ray papers, are also followed by discussion.

The proportion of space given to problems of a highly practical nature is unusually large. The brass foundry superintendent will find this volume of as much interest as will the metallurgist. H. W. Gillett (15) -B-

The Pretoria Iron and Steel Works. *Engineer*, Vol. 161, Jan. 24, 1936, pages 94-97. Illustrated article describing the Pretoria Works of the South Africa Iron, Steel and Industrial Corporation. The coke-ovens, blast-furnaces, steel-furnaces and rolling mills and the by-products plant are described. Statistics of the materials consumed by these departments as well as production and revenue figures are given.

LFM (15)

Mechanical Technology of Metals (Mechanische Technologie der Metalle) Hermann Meyer. Dr. Max Jänecke, Verlagsbuchandlung, Leipzig, 1935. Paper, 5¾ x 8¼ inches, 355 pages. Price 6.20 RM. In this new edition attention is given to the work of the German Standards Committee. As the economic situation in Germany necessitates industry freeing itself of using foreign materials, the importance of "home" materials is mentioned where suitable.

An addition made since the last edition, is a discussion of non-metallic raw materials. Molded compounds are considered as they have displaced metals.

The contents of the book are as follows: I. The metals of importance in machine construction, Iron, the production of Pig Iron, Steel, Non-ferrous metals and alloys, the testing of metals. II. The Forming of Metals by Casting, the Iron Foundry, the Steel Foundry, Non-Ferrous Castings. III. The Forming of Metals by Working, Forging, Hot Pressing of Non-ferrous Metals and Alloys, Rolling, Manufacture of Tubes, Wire Drawing, Upsetting. IV. Welding. V. Soldering. VI. Hardening. VII. Non-metals important for Machine Construction, Wood, Leather, Rubber, Molding Compounds, Lubricants. Richard Rimbach (15) -B-

Department of Scientific and Industrial Research, Report for the Year 1934-35. His Majesty's Stationery Office, London, 1935. Paper, 6¼ x 9½ inches, 185 pages. Price 3s.

In the introduction, Lord Rutherford points out that 13 research associations in England are earning grants from the government, based on obtaining support from the industry concerned. About £200,000 are thus available from the government. The metallurgical research associations are British Non-Ferrous Metals, British Cast Iron, and British Iron & Steel Federation.

The metallurgical research under the Department is, of course, chiefly carried out at the National Physical Laboratory. A separate report on the N.P.L. work has already been published. Some of the work of other organizations that is of metallurgical interest is: the Food Research Board made tests showing that aluminum cans are unsuitable for canning fruits, and that small amounts of Sb or Bi in Sn inhibit attack by dilute citric acid; the Building Research Station is studying high tensile structural steel; the Chemical Research Laboratory is working on immersed and atmospheric corrosion, with a special investigation on boiler tubes; supra-conductivity is being studied at Cambridge, the Cast Iron Association is working on methods of control of graphite structure, on quality of coke, etc.; the Iron & Steel Federation on ingot molds, oxygen determinations, etc., and the Non-Ferrous Association is engaged on some 50 projects.

The Refractories Research Association is concerned with blast furnace refractories; the Paint Association has published a paper on painting of galvanized iron, while the Automobile Engineers Research Committee is studying cylinder wear and corrosion, valve seat wear and lubricating oil consumption. H. W. Gillett (15) -B-

Metallurgical Section, International Congress of Mines, Metallurgy and Applied Geology, Vol. 1. (Congrès International des Mines, de la Métallurgie et de la geologie Appliqueé. Secion de Métallurgie. Tome 1.) Revue de Métallurgie, Paris, 1936. Paper, 9 x 11 inches, 476 pages. Price 86 Fr.

This volume includes 44 articles by well known authors from many countries, including J. F. Thompson, E. C. Bain and Prof. Sauveur from the U. S., Hadfield, MacNaughtan, Haigh, Evans, etc. from England, Benedicks from Sweden, Giolitti from Italy, Ros and Eichinger from Switzerland, to mention only a few, while Portevin, Chevenard, Perrin, Guillet, Ballay, Billiter, etc. are among the French authors. A wide range of subjects is covered, blast furnace design, electroplating, purified Al, flaky steel, Mo, Al, Mg alloys, oxide coatings on Al, electric cast iron, alloy iron, malleable, die castings, aging of steel, welding, forgeability, nitriding, high temperature testing, fatigue testing, etc., etc.

The articles are appearing in Revue de Métallurgie and are abstracted from that source. H. W. Gillett (15) -B-

Metallurgical Research. Recent Trends and Future Developments. Harold Moore. *Metal Industry*, London, Vol. 6, May 3, 1935, pages 483-484; May 17, 1935, pages 535-538. See *Metals & Alloys*, Vol. 7, Feb. 1936, page MA 87R/4. HBG (15)

Tubes Enter the Automobile Plant. R. A. Powers. *Electronics*, Vol. 8, Sept. 1935, pages 276-279. Phototubes provide an accurate method for automatic control of heat treating operations. For less accurate temperature control electronic time delays are recommended. Phototube inspection of wrist pins with automatic grading in size to nearest 0.00001″ is also described. DJM (15)

Temperature Measurement on Liquid and Solid Metals Demonstrated by the Example of Iron (Temperaturmessung an flüssigen und festen Metallen dargestellt am Beispiel des Eisens). Rudolf Hase. *Zeitschrift Verein deutscher Ingenieure*, Vol. 79, Nov. 9, 1935, pages 1351-1355. Measuring of temperature by pyrometer, thermocouple, melting substances, change of color, metallographic and dilatation methods are briefly reviewed. 21 references. Ha (15)

The Engineering Development of Electrochemistry and Electrometallurgy. Paul Bunet. *Electrical Engineering*, Vol. 54, Dec. 1935, pages 1320-1331. The problem of supplying electric power to these industries and development of certain processes illustrating direct uses of electricity in industrial processes are described. 7 references. Ha (15)

Status of the Ferrous Metallurgical Industry in Spain. D. Jose Serrat y Bonastre & F. R. Morral. *Metals & Alloys*, Vol. 6, Aug. 1935, page 218. Statistical and descriptive. WLC (15)

Steel Making Plant of Urals-Kouznetsk (Les usines sidérurgiques de l'Oural Kouznetsk) J. Vishniak. *Génie Civil*, Vol. 107, Nov. 30, 1935, pages 507-513. Description of steel making equipment starting with coke ovens. JDG (15)

Cooperative Research in Metallurgy. Charles R. Austin. *Mineral Industries, Pennsylvania State College*, Vol. 5, Dec. 1935, pages 1-2. The functions of cooperative research in metallurgy are (1) to train students to apply efficiently their basic theoretical knowledge to the elucidation of metallurgical problems and (2) to conduct research basic to the metallurgical industry. AHE (15)

Inauguration of the New Building of the Kaiser-Wilhelm Institute for Iron Research (Zur Einweihung des Neubaues des Kaiser-Wilhelm-Instituts für Eisenforschung) F. Körber. *Zeitschrift Verein deutscher Ingenieure*, Vol. 79, Nov. 30, 1935, pages 1431-1433. Description and illustration. Ha (15)

15a. Economic

Standardization of Aluminum Bars for Electric Installations (Die Normung von Aluminium-Schienen für elektrische Schaltanlagen) K. Kupper & F. Streiff. *Aluminium,* Vol. 17, Nov. 1935, pages 579-585. Tests are described to determine admissible current capacity for Al bars in electric switching installations. On the basis of these tests, specifications of materials and current capacity have been laid down for d.c. and a.c. Ha (15a)

Copper, Lead and Zinc Mining in 1935—Advance Summary. O. E. Kiessling. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 437, Jan. 27, 1936, 3 pages. Statistical. AHE (15a)

South Africa's Base Metal Markets. L. Moshal. *South African Mining & Engineering Journal,* Vol. 46, part II, Oct. 26, 1935, page 231. Optimistic prediction. AHE (15a)

Nickel Production in Brazil (Produccao de Nickel no Brasil) *Chimica e Industria,* Vol. 3, Oct. 1935, page 137. Brief statistical data of deposits of Ni ore in the various states of Brazil. The average content is 4%, but there exist some deposits with 4-8%, and even 14%. The export in the years 1933 and 1934 amounted to 470,000 and 386,505 kg. respectively. Ha (15a)

The Steel Output and Outlook. *Engineering,* Vol. 140, Dec. 27, 1935, pages 696-697. The world's production and consumption of steel is greater now than in 1913 in spite of present-day business difficulties. Except for France, Belgium, Luxemburg and India, the increased tonnage is used for home consumption. The United States is exporting only 1/3 of her pre-war tonnage, Germany and Great Britain little more than ½ of their 1913 tonnage. Belgium is exporting less than twice its 1913 tonnage, France 3 times and India 6 times as much as in 1913. LFM (15a)

The Science of Metals Grows Apace—Many New Alloys and Methods of Treatment. *Mining & Metallurgy,* Vol. 17, Jan. 1936, pages 42-49. A number of contributions by various authorities on non-ferrous metals and alloys. "Nonferrous physical metallurgy," by Robert F. Mehl; "Secondary metals more closely examined" by W. Romanoff; "New lead and tin alloys in batteries, bearings, and bullets" by George O. Hiers; "New and old aluminum alloys meet a rapidly expanding demand" by L. W. Kempf; "Brass and copper mills continue efforts to secure highest quality in products" by John L. Christie; "Wide diversification in use leads to biggest year in nickel" by Robert C. Stanley; "Die castings and electrogalvanizing boost use of purest zinc" by W. M. Peirce; "Several new developments in use of silver and precious-metal alloys" by Robert H. Leach; and "Magnesium-alloy products improve in quality and size" by John A. Gann. VSP (15a)

35,000,000 Tons, 1936 Ore Estimate; Deals in Vessels. *Steel,* Vol. 98, Feb. 17, 1936, pages 27-28. Includes review of Lake Superior Fe-ore industry. Tabulates shipments by the different mines in 1934 and 1935. Total in 1935 was 28,503,501 tons compared witht 22,063,824 tons in 1934. In 1935, 1,717 tons of lake ore were used to make 1 ton of pig-Fe produced with lake ore. MS (15a)

Further Progress in Production and Use of High-Grade Zinc—Oxide Situation Interesting. Frank G. Breyer. *Mining & Metallurgy,* Vol. 17, Jan. 1936, pages 24-26. Following developments in the field of metallic Zn during 1935 are listed in order of their importance: (1) Construction of further continuous vertical retort smelting capacity in United States and Germany; (2) expansion of fractional distillation capacity; (3) expansion in Zn-base die casting in United States and abroad; (4) wide acceptance of heavy galvanizing by steel industry; (5) construction of first commercial wire electroplating plant for putting on heavy coats of pure Zn; and (6) use of Zn dust as reducing agent in organic chemical industry. In the field of Zn compounds: (1) Decrease in use of ZnO in rubber compounding; (2) wider appreciation of leaded ZnO in paint; (3) threat of Ti inert combination to lithopone in the bulk whitening field; and (4) threat to TiO of ZnS as better value where concentrated whitening powder is needed. VSP (15a)

Iron and Steel in Automobile Construction (Eisen und Stahl im Automobilbau) Böker. *Automobiltechnische Zeitschrift,* Vol. 39, Feb. 15, 1936, page 55. Some statistical figures on consumption in the German automobile industry. Ha (15a)

Mining Operations in the Province of Quebec During the Year 1934. A. O. Dufresne. *Annual Report, Quebec Department of Mines,* 1934, Part A, 202 pages. Statistical and descriptive, covering Cu, Au, Ag, Cr, Mo, Se and Ti. AHE (15a)

Metal Mining in Washington, 1935—Advance Summary. C. N. Gerry & Paul Luff. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 425, Jan. 18, 1936, 2 pages. Statistical. AHE (15a)

Metal Mining in Idaho, 1935—Advance Summary. C. N. Gerry & Paul Luff. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 422, Jan. 18, 1936, 3 pages. Statistical. AHE (15a)

Metal Mining in Arizona, 1935—Advance Summary. C. N. Gerry & Paul Luff. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 432, Jan. 20, 1936, 4 pages. Statistical. AHE (15a)

Metal Mining in Nevada, 1935—Advance Summary. H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 421, Jan. 16, 1936, 5 pages. Statistical. AHE (15a)

Metal Mining in Oregon, 1935—Advance Summary. H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 433, Jan. 24, 1936, 4 pages. Statistical. AHE (15a)

Yugoslav Metallurgical Industry (Die Yugoslawische Metallindustrie). *Die Metallbörse,* Vol. 25, Mar. 6, 1935, page 292; Mar. 9, 1935, page 308; Mar. 13, 1935, page 324. Ore deposits, mining, export and domestic production of Fe, Cu, Pb, Zn, Al, Mn, Cr and Sb are discussed and statistics on these metals are given dating back to 1925. EF (15a)

Metal Mining in California, 1935—Advance Summary. H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 426, Jan. 24, 1936, 5 pages. Statistical. AHE (15a)

Metal Mining in Texas, 1935—Advance Summary. Chas. W. Henderson & A. J. Martin. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 430, Jan. 20, 1936, 2 pages. Statistical. AHE (15a)

Metal Mining in New Mexico, 1935—Advance Summary. Chas. W. Henderson & A. J. Martin. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 428, Jan. 20, 1936, 2 pages. Statistical. AHE (15a)

Metal Mining in South Dakota, 1935—Advance Summary Chas. W. Henderson & A. J. Martin. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 429, Jan. 23, 1936, 2 pages. Statistical. AHE (15a)

Metal Mining in Montana, 1935—Advance Summary. T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 423, Jan. 17, 1936, 3 pages. AHE (15a)

Lead Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 434, Jan. 21, 1936, 2 pages. Statistical. AHE (15a)

Copper Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 435, Jan. 17, 1936, 3 pages. Statistical. AHE (15a)

The Economic Importance of the Replacement of Obsolete Equipment in Steel Mills. D. M. Petty. *Mill & Factory,* Vol. 16, June 1935, pages 44-48, 111. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 89L/8. WH (15a)

Non-Ferrous Metals in the Near East. Alfred Marcus. *Metal Industry,* London, Vol. 47, Aug. 9, 1935, pages 133-134, 138. This is an economic discussion of the potentialities of the non-ferrous metal market in the Near East. Production is in its infancy although until the world-wide economic crisis the quantities of certain metals produced was gradually increasing. At present there is little likelihood of any activities along this line as the prices of the metals are too low to make the work profitable. HBG (15a)

The Economics of Old Metals, Especially Copper, Lead, Zinc, and Tin. W. R. Ingalls. *Mining & Metallurgical Society of American Bulletin* No. 235, Vol. 28, Nov. 1935, pages 75-95; *Mining Journal,* Vol. 191, Nov. 30, 1935, pages 899-902; Dec. 7, 1935, pages 932-933. AHE (15a)

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■ 15b. Historical ■

Iron and Railroad (Eisen und Eisenbahn) G. HAMMER. *Stahl und Eisen,* Vol. 55, Dec. 5, 1935, pages 1451-1455. Historical, on 100th anniversary of the German railways; 40 million tons of steel have been used to-date in the German railways. SE (15b)

Aluminum—From a Chemical Element to an Industrial Metal. ZAY JEFFRIES. *Iron Age,* Vol. 137, Feb. 20, 1936, pages 22-28. An historical review of Al, considering the work of various investigators, with special reference to the work of C. M. Hall. In addition discusses the magnitude of the industry and the industrial applications of Al products VSP (15b)

Skyscraper Born 50 Years Ago; Raised on Steel. V. G. IDEN. *Steel,* Vol. 98, Feb. 24, 1936, pages 16-18. History of the use of Fe and steel as structural members in buildings. Cast-Fe beams and columns were first used in an English building in 1801. Wrought-Fe joist section was rolled in Paris in 1849. First wrought-Fe joists rolled in England were in 1860. First steel joists were rolled in England in 1885. Rolled steel sections were available in the U. S. in 1884. Home Life Insurance Building in Chicago, built in 1884-1885, was first modern building to use structural steel. It was started with wrought-Fe beams, and before completion, bessemer steel beams were used. Open-hearth steel shapes were rolled in 1891. Wrought-Fe shapes were discontinued in 1894. MS (15b)

Copper and Old Heating Materials (Le Cuivre et l'ancien Material de Chauffage) G. DUBOIS. *Cuivre et Laiton,* Vol. 9, Mar. 15, 1936, pages 103-105. A historical review of pipe lines, steam producers, heating plants in which Cu was used almost exclusively. Ha (15b)

MANUFACTURERS' LITERATURE

Colmonoy

Bulletin No. 50 which is devoted to the wear-resistant, corrosion-resistant and heat-resistant alloys and overlay metals is published by the Colmonoy Co., Los Nietos, Calif. (680)

Refractories

Pyro Steel fire brick is the subject of a pamphlet which contains a typical analysis of the material, as well as information as to its characteristics, among which are high fusion point, slow vitrification and low permanent shrinkage. Pyro Clay Products Co., Oak Hill, O. (681)

Amaloy Prevents Corrosion

Amaloy is a hot dipping process which coats the base metal with a single solid solution of lead. The manufacturer claims that it adheres and forms a permanent protective coating for forged, drawn or rolled steel, brass and copper. American Machine & Foundry Co., New York, N. Y. (682)

Permite Six Foot Cast Bronze Bars

An attractive booklet states that these bars assure a product identical in physical and wear resisting qualities with the finest individual castings. Joseph T. Ryerson and Son, Inc., Chicago, Ill. (683)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (684)

Coreless Induction Furnace

A colorful leaflet contains an explanation of the principle of operation and advantages to be obtained from the use of the Ajax-Northrup electric furnaces. Ajax Electrothermic Corp., Trenton, N. J. (685)

Flame-Otrol

This automatic gas shut off which is simple, positive in operation and operates with split second speed, according to the manufacturer, is the subject of an illustrated pamphlet. Thermo Control Devices, Inc., Chicago, Ill. (686)

Braze-Rite Furnace

This furnace, developed principally for brazing sintered carbide cutting tools, provides for localized heat to be applied only to the portion of the tool to be brazed. The sintered carbide blank to be brazed in place is merely laid onto the shank and after the proper heat has been obtained the blank is firmly pressed onto the shank—all controlled under a hydrogen atmosphere. Illustrated. Firth-Sterling Steel Co., McKeesport, Pa. (687)

Industrial Proportioning

Bulletin No. 1529 states that this company offers a complete line of proportioning equipment and weighing apparatus for granular and liquid materials used in industrial processes. Devices of the following types are furnished: manual operation; manual operation with electrical interlocks to automatically control accuracy of proportioning; semi-automatic operation—consisting of power operated filling and discharge gates for the proportioning equipment; and full automatic proportioning equipment with remote control. Illustrations. Blaw-Knox Co., Pittsburgh, Pa. (688)

Alloy Steels

A colorful folder devoted to these steels lists some of the advantages to be obtained by their use. Bliss & Laughlin, Inc., Harvey, Ill. (689)

Industrial Furnaces

A well-illustrated circular contains data on this company's various types of furnaces. High speed furnaces, car bottom furnaces, galvanizing and tinning furnaces are a few of the types mentioned. Chicago Flexible Shaft Co., Chicago, Ill. (690)

The 92 Elements

A leaflet contains data on the 92 elements relating to X-ray work. St. John X-Ray Service, Inc., Long Island City, N. Y. (691)

The Jetal Process

Simple immersion in an aqueous bath for about 5 minutes colors all grades of common iron or steel a brilliant and uniform jet black. It is claimed it does not alter dimensions of articles and cannot chip, scale, peel or discolor. Alrose Chemical Co., Providence, R. I. (692)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (693)

Furnaces

Information concerning Hausfeld modern melting equipment for die casting is featured in an illustrated leaflet. These furnaces are made interchangeable for oil or gas fuel. Campbell-Hausfeld Co., Harrison, O. (694)

Duo Metals

A colorful bulletin discusses the advantages of the Duo process which makes it possible to weld a high alloy steel capable of being forged to any alloy steel. Illustrated. Latrobe Electric Steel Co., Latrobe, Pa. (695)

Spencer Turbo-Compressors

This bulletin which has illustrations of the complete range of sizes of this equipment also contains: "Midget" Turbo for individual mounting, a single-stage line which effects new economies and Gas-Tight Turbos for acid and explosive gases. Spencer-Turbine Company, Hartford, Conn. (696)

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (697)

Sand Control in the Foundry

A colorful pamphlet lists the major causes of casting defects and inferiorities and states that they may be avoided by the use of the proper sand control equipment. Illustrated: Harry W. Dietert Co., Detroit, Mich.

Published by the same company: "The Core Maker"—a leaflet and "Deformation and Resilience Accessory for Universal Sand Strength Machine"—looseleaf data sheet. (698)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (699)

Centrifugal Castings

Advantages, analyses of metal—sizes of tubes, application, machining and welding and production facilities of those castings are discussed in an illustrated folder of The Duraloy Co., Pittsburgh, Pa. (700)

High Temperature Insulation

For all types of heated equipment is the subject of an illustrated leaflet issued by Armstrong Cork Products Co., Lancaster, Pa. (701)

Copper Alloy Steel Sheets

In an attractive, illustrated booklet it is claimed that the major attributes of a satisfactory sheet metal—workability, durability and usefulness—characterize this company's steel sheets. Inland Steel Co., Chicago, Ill. (702)

Enduro

Data on the welding of Enduro stainless steels are given in a colorful brochure. Electric arc, gas, spot and projection, seam, flash, atomic hydrogen welding and brazing and silver soldering are features of this discussion. A complete list of products is included. Illustrated. Republic Steel Corp., Massillon, O. (703)

Industrial Dust Control

This book charts the progress made by various types of dust collecting systems to the present time, outlining the advantages that modern dust control brings to industry today. Chapters on: exhaust hoods and piping system; dust collecting equipment; types of collectors in general use in the industrial field; and the operation and maintenance of exhaust systems are featured. Pangborn Corp., Hagerstown, Md. (704)

Electric Thermometers

Bulletin No. 2451 is devoted to the standard types of "Alnor" electric resistance thermometers which, it is claimed, should be used where readings of low temperature values are desired, and where unusual accuracy and distant readings are required. Illustrated. Illinois Testing Laboratories, Inc., Chicago, Ill. (705)

Adjustable Lighting Equipment

An illustrated bulletin dealing with the Herald-Lite type of adjustable lighting fixtures for use in machine shops, plants, drafting rooms, etc. Herrold Co., Richmond Hill, N. Y. (706)

Ferrocarbo

This material containing both silicon and carbon combined in the form of silicon carbide, acts as a graphitizer or softener when added to cast iron. The compound is broken up and the Si and C react vigorously with the Fe with an exothermic effect when the Ferrocarbo comes in contact with the molten Fe. The manufacturer claims that when Ferrocarbo is used with a properly adjusted charge, the fine graphite structure and high strength characteristic of a hard charge are combined with a high degree of machinability. Carborundum Co., Niagara Falls, N. Y. (707)

MANUFACTURERS' LITERATURE

Molybdenum in Iron and Steel

An attractive brochure contains a summary of the part played by molybdenum in ferrous progress, and claims that a great saving in cost with no impairment in quality can be obtained by its use. The Climax Molybdenum Co., New York, N. Y. (754)

Temperature Control Instruments

Bulletin 33 is devoted to instruments for automatic control of temperatures in industrial furnaces. Illustrated. American Electric Furnace Co., Boston, Mass. (755)

Value of Draft Control

Bulletin No. L-125 is devoted to the above subject and points out the proper value of the furnace draft and this company's control which consists of a draft switch, a damper motor and a manual station. Illustrated. Shallcross Controls, Inc., Milwaukee, Wis. (756)

Heat Exchanger

Bulletin No. 173 describes the Duriron heat exchanger which is available in the company's corrosion-resisting alloys—Duriron, Durichlor, Durimet, Durco Alloy Steel and Alcumite. Illustrated. Duriron Co., Dayton, O. (757)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (758)

Spectrometric Equipment

Catalog D-221 is devoted to the above equipment. Basic theory and design are described as well as the various types of instruments. Illustrated. Bausch & Lomb Optical Co., Rochester, N. Y. (759)

Granite City HS Grades 1 and 2

Information concerning the Granite City manganese high tensile steels can be obtained from the Granite City Steel Co., Granite City, Ill. (760)

Phosphor Bronze

A leaflet lists the sizes in which the company's twelve-inch stock bushing bars are now offered. The Phosphor-Bronze Smelting Co., Philadelphia, Pa. (761)

Wheelabrator Tum-Blast Cleaner

This cleaner, which it is claimed sets the highest standard of efficiency ever attained in an abrasive cleaning machine is a combination of the Tum-Blast Cleaner and the Wheelabrator. Book 111 is devoted to it. American Foundry Equipment Co., Mishawaka, Ind. (762)

Industrial Furnaces

This catalog describes, illustrates and gives specifications for furnaces suitable for various applications. Mahr Manufacturing Co., Minneapolis, Minn. (763)

Research Puts the Diatom to Work

This booklet discusses the history of the diatom from which Celite is made. The four main industrial services of Celite: high temperature insulation, a filter aid, mineral filler and workability agent in concrete are described. Illustrated. Johns-Manville, New York, N. Y. (764)

Inhibitor

Grasselli 3 inhibitor for efficient, economical pickling is the subject of a booklet of The Grasselli Chemical Co., Inc., Cleveland, O. (765)

A. W. 70-90

This bulletin describes the new high-strength "70-90" steel in sheets and plates. An article on the engineering aspect of high-strength sheet steels is included. Alan Wood Steel Co., Conshohocken, Pa. (766)

Dolomite Refractories

This interesting pamphlet presents the case of Clinkered vs. Calcined Dolomite in the basic open-hearth steel furnace. Basic-Dolomite, Inc., Cleveland, O. (767)

Controlled Grain Anodes

Seymour Nickel Anodes are homogeneous in grain structure, according to this bulletin. The various available shapes are illustrated and some useful data are given. The Seymour Manufacturing Co., Seymour, Conn. (768)

Welding Rods

Hard-facing welding rods Nos. 459 and 217 are the subjects of an illustrated brochure. Hard surfacing can be done with these rods, either electrically or by the oxy-acetylene process to the great majority of ferrous welding parts. American Manganese Steel Co., Chicago Heights, Ill. (769)

Polishing Machines

A portable model and a floor model of these new metallographic machines are described and illustrated in a pamphlet from Eberbach & Son Co., Inc., Ann Arbor, Mich. (770)

Electromet Review

This publication, whose purpose is to brings "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (771)

Modern Metal Treatment

A colorful pamphlet lists the R & H chemicals available for heat-treating, electroplating and for cleaning metals. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (772)

Heat and Corrosion Resistant Alloys Heated By Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (773)

Sicromo Steel

High temperature data sheets containing full information on this steel have been issued by The Timken Steel & Tube Co., Canton, O. (774)

Centrifugal Castings

Bulletin C-2 is devoted to these castings which are available in the same analyses as the stationary-cast range of heat and corrosion resistant alloys which they supplement. Michigan Steel Casting Co., Detroit, Mich. (775)

Metallurgy of Wire Manufacture

This paper contains valuable and interesting data and was presented by H. W. Graham, general metallurgist of Jones & Laughlin Steel Corp., Pittsburgh, Pa. (776)

Weatherproof Line Wire

Publication GEA-2103 gives information on a new wire with varnished cambric and a weatherproof braid treated with U.R.C. compound. General Electric Co., Schenectady, N. Y. (777)

Bearing Security

This leaflet lists the four essentials of a bearing metal and claims that Ajax Bull Bearing alloy embodies them. Ajax Metal Co., Philadelphia, Pa. (778)

Rocking Furnace

Type G-M is a small-scale indirect arc electric furnace designed for iron, steel, brass, copper and nickel alloy. The furnace is illustrated and specifications are included in a leaflet which has been prepared by the Detroit Electric Furnace Co., Detroit, Mich. (779)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. It is claimed that this series represents the best straight cutting oils obtainable, at a price which meets and beats competition. E. F. Houghton & Co., Philadelphia, Pa. (780)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (781)

Flex-Arc Rays

Data bulletins containing information on arc welding are published by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. (782)

Sixteen Sins of the Cleaning Room

Are listed in a circular for convenience in checking on cleaning rooms. Great Lakes Foundry Sand Co., Detroit, Mich. (783)

Refractory Cement

Bulletin No. 317, describes Q-Chrome neutral-base refractory cement which was designed for severe-service duty. Quigley Company, Inc., New York, N. Y. (784)

Meehanite Metal

A specification chart of recommended grades for various service requirements has been issued by the Meehanite Metal Corp., Pittsburgh, Pa. (785)

Arc Welding

A book "Automatic Arc Welding by the Electronic Tornado" gives a full explanation of this system of automatic carbon arc welding. Lincoln Electric Co., Cleveland, O. (786)

Centrifugal Compressors

Bulletin 386 is devoted to this company's Design 9 Compressors. Illustrated. B. F. Sturtevant Co., Boston, Mass. (787)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections Available Forms and Shop Practice, has been published by The Dow Chemical Co., Midland, Mich. (788)

CURRENT NEWS ITEMS

A New Film—"Super-Refractories Through the Microscope"

A very unique motion picture film entitled "Super-Refractories through the Microscope" has been developed by the research laboratories of The Carborundum Co. and is available for showing before interested technical societies.

The first part of the film was made by the kodachrome process and shows the structure of various refractory materials as they are revolved on the stage of the polarizing microscope. The second part of the film was made by means of the newly developed thermal microscope and gives a graphic demonstration of the actual behavior of various types of refractories under severe operating conditions.

The first public showing of the film was given at the convention of the American Ceramic Society in March, 1936, and the comments of the large audience were to the effect that not only were the pictures themselves of great interest but they were concrete evidence of the development of a new laboratory technique that was a worthwhile contribution to the interests of manufacturers and consumers of refractories. Interested societies can arrange for showings through the refractory division of The Carborundum Co., Perth Amboy, N. J.

Testing Society's New Officers

At the annual meeting at Atlantic City of the A.S.T.M. in June the following new officers for the ensuing year were elected: President (1 yr.), A. C. Fieldner, chief engineer, experiment station division, U. S. Bureau of Mines, Washington; vice-president (2 yrs.), T. G. Delbridge, manager, research and development department, Atlantic Refining Co., Philadelphia; members of the executive committee (2 yrs.), O. U. Cook, assistant manager, department of metallurgy, inspection and research, Tennessee Coal, Iron & Railroad Co., Birmingham; H. F. Gonnerman, manager, research laboratory, Portland Cement Assn., Chicago; C. S. Reeve, manager, research development, The Barrett Co., Leonia, N. J.; F. E. Richart, research professor of engineering materials, University of Illinois, Urbana, Ill., and F. M. Waring, engineer of tests, Pennsylvania Railroad, Altoona, Pa.

Mr. Fielder, the new president, has been prominent for a number of years in Government departments and has been active in A.S.T.M. committee work. He has been active also in developing standard methods and apparatus for analyzing coal, and the author and co-author of many scientific and technical papers. The honorary degree of Doctor of Science was recently awarded to him by the University of Alabama.

National Founders Assn. Has Consulting Foundry Engineer

The National Founders Association announces the engagement of Gottfrid Olson as consulting foundry engineer. Mr. Olson served his apprenticeship in Sweden, and has worked in the United States some 20 years as molder, foreman and superintendent. He is a graduate engineer (Swedish Government Technical School), and his early education has been supplemented by special courses in metallurgy and allied subjects at schools in this country.

Mr. Olson's work with the association will cover foundry practice, production problems, equipment, apprenticeship, safety and sanitation. He is thoroughly informed on the dust hazard and practical methods for its control.

Honorary Degree for Dr. Fink

Dr. Colin G. Fink, head of the department of electrochemistry, Columbia University, and secretary of The Electrochemical Society, was recently given the honorary degree of Doctor of Science by Oberlin College, Oberlin, Ohio. The citation reads: "Master of Metals, Servant of Learning, of Industry, and of Art. Benefactor through brilliant Invention." Dr. Fink will be the American guest speaker at the Twelfth Conference of the International Chemical Union in Switzerland in August when his topic will be "The Electro-chemical Protection of Iron and Steel against Corrosion."

New Research Associate Plan at Battelle

The Trustees of Battelle Memorial Institute have announced a new plan to extend the scope and utility of the educational features of the institute's basic program of scientific research. Since its inception, the policy of Battelle has been to combine a program of fundamental research of general interest to industry with the applied research which it has carried on for individual companies and associations under its plan of sponsored research.

A new Division of Research Associates has been established to supplement the work in fundamental science of the regular technical staff. The purpose of this new division is to offer intensive training in practical research to the best of the younger workers in selected branches of chemistry, metallurgy, fuels and ceramics. Appointments as research associate will be made for one year's duration and may be extended for a second year. A research associate will be expected to devote his entire time to a research problem approved by the director and supervised by members of the staff. The results of these researches will be published in order to contribute information that will be useful to science and industry.

Appointments as research associate are open to graduates of any accredited university or college, but preference will be shown to men who have demonstrated a marked aptitude for scientific research in their industrial experience or through one or more year's graduate study. The appointment will carry an annual salary of from $1200 to $1800 depending on the training and experience of the individual. Four appointments as "Battelle Research Associate" will be made for the year 1936-1937. Applications may be obtained from the director, Battelle Memorial Institute, Columbus, Ohio.

H. C. Mann Awarded Dudley Medal

The Charles B. Dudley Medal, awarded annually by the A.S.T.M., was bestowed this year on H. C. Mann, senior materials engineer, ordnance department, U. S. Government, Watertown Arsenal, at the annual convention in June at Atlantic City. This medal commemorates the name of the Society's first president, 1902-1909, and is awarded to the author of the paper presented at the previous annual meeting which is of outstanding merit and which constitutes an original contribution on research in engineerng materials.

The Mann's paper was entitled "The Relation Between the Tension Static and Dynamic Tests" and presents data and conclusions from an investigation which led to the discovery of a correlation between static and dynamic tests.

The medalist was educated at Worcester Polytechnic Institute and Boston University and has been at Watertown Arsenal since 1916.

C. E. Sims Joins Battelle

Clyde E. Williams, director, Battelle Memorial Institute, Columbus, Ohio, has announced the appointment of C. E. Sims, as research metallurgist at Battelle. Mr. Sims, formerly assistant director of research for the American Steel Foundries, Indiana Harbor, has had an exceptionally wide experience in steel foundry practice. He is the author of numerous technical papers and with G. A. Lilliequist was awarded the Robert W. Hunt prize by the American Institute of Mining and Metallurgical Engineers in 1933 for the paper, "Inclusions, Their Effect, Solubility and Control in Cast Steel."

H. A. Schwartz Honored

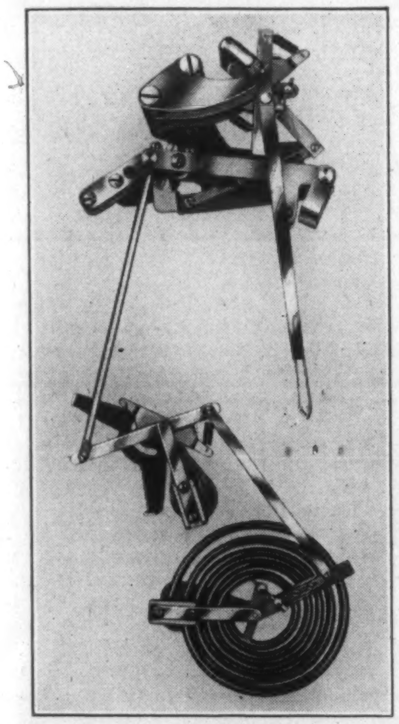
Harry A. Schwartz, National Malleable and Steel Castings Co., Cleveland, was awarded the honorary degree of Doctor of Science by Case School of Applied Science of that city at its 52nd Commercement in June. He also delivered the annual Sigma Xi lecture before the Case chapter when he discussed "Our Debt to Josiah Willard Gibbs."

NEW EQUIPMENT AND MATERIALS

Automatic Pressure Compensator

In measuring the flows of compressible fluids such as steam, air and gas, variations in the static pressure of the flow directly influence the flow reading. To prevent errors from this source, The Foxboro Co., Foxboro, Mass., has developed the "Automatic Pressure Compensator" for Foxboro flow meters.

The mechanism is merely a simple spiral pressure tube connected to a lever. As the line pressure changes, the spiral adjusts the multiplication of the linkage between the float and pen arm. This is not an additive correction but a percentage correction; the linear amount of correction differs at different points of the chart and is calibrated to fit the flow formula of the meter. Thus a continuous, instantaneous and accurate compensation for pressure changes is obtained automatically. The compensator is sensitive to, and will correct, the position of the flow pen for a change in pressure as small as 1-10 of 1 per cent.



At zero flow, pressure changes do not affect the position of the flow pen; at all other points on the chart the shift in pen position is just sufficient to compensate for the effect of this factor in the flow formula. On square-root flow scale meters the pen position is varied proportionately to the change in absolute pressure; on uniform flow scale meters, pen position is varied proportionately to the square root of change in absolute pressure. Should maximum flow and maximum pressure occur simultaneously, the pen will not travel beyond the upper chart limit.

If at any time a pressure-compensating meter is changed over to a service where compensation is not required, the meter is easily adapted to the new service. By attaching one screw on the compensator to the mounting post in the instrument, the compensator becomes inoperative and the differential calibration is that of a non-compensating meter. The Automatic Pressure Compensator does not affect the inclusion of pens for recording pressure or temperature.

An Insulated Electrode Holder

At least 90 per cent of the flashes that welders get are caused by conatcting the ordinary bare type electrode holder with grounded parts. To eliminate such flashes, to provide a maximum degree of safety for the operator and protection for the work and to provide longer and more economical holder service, the Jackson Electrode Holder Co., 6553 Woodward Ave., Detroit, is introducing a new model embodying radical improvements in design.

The new holder, like previous Jackson holders, is completely insulated, air circulation being provided between insulation and metal to achive coolness. In spite of the insulation, total weight of the holder is about that of bare type holders of comparable capacity. A special copper alloy has been adopted for the structural parts of the holder, combining strength with adequate conductivity.

But as the jaws of any holder are the parts first to burn out, this new holder is provided with replaceable jaws of "Mallory 3 Metal," a copper alloy that is already widely used for spot welding tips, flash welding dies and seam welding wheels. It combines the tensile and elastic properties of structural steel with the high electrical conductivity and corrosion resistance of pure copper. This jaw construction has unusually long life and, when jaws ultimately do become worn, replacement is simple, easy and economical, adding indefinitely to the life of the holder.

Armco Stabilized Steel

Full commercial production of "Armco Stabilized Steel" in cold rolled sheets and strip has been announced by the American Rolling Mill Co., Middleton, Ohio.

Stabilized steel is offered by the company as uniform, deep-drawing and non-aging cold rolled steel with all stretcher strain permanently eliminated in the tempered condition. It retains indefinitely all of the properties of temper-rolled steel, making prefabrication treatments unnecessary, regardless of the length of time the metal has been in stock.

Unlike ordinary mild steels for deep drawing purposes, the new metal has no sharp yield point in the temper rolled condition. It is superior in resistance to cracking in some very severe drawing operations, and it will retain its initial excellent drawing properties indefinitely, the company claims.

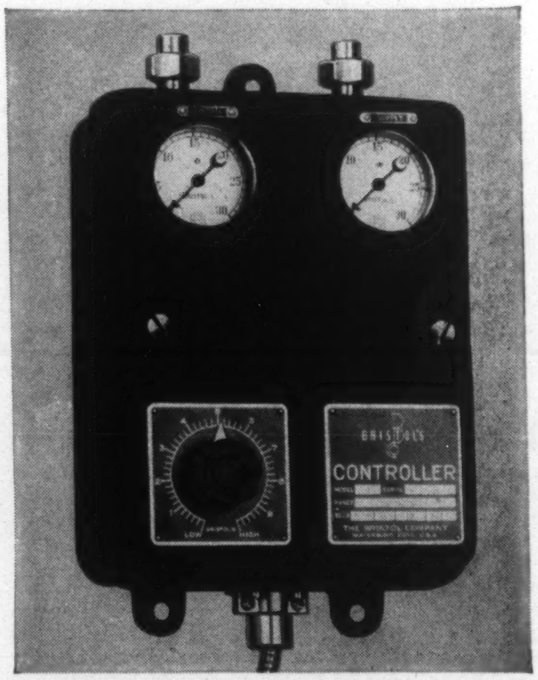
In the general run of mild steel sheets, a sharp yield point develops within a comparatively short time after cold rolling, depending upon the aging temperatures to which they are subjected. It has been found that at 212 deg. F., the "yield point elongation" increases continuously and reaches a maximum after about two weeks at this temperature. The same changes occur at room temperature, but require days instead of minutes for their consumation.

Manufacturers of products in which high finish, deep drawing steel sheets are used have realized that aging in their plants has aggravated breakage and stretcher straining difficulties. Many users of drawing steel will be greatly interested in this development.

Pneumatic Type Temperature Controller

The Bristol Co., Waterbury, Conn., announces a new pneumatic-type controller for temperature, pressure and liquid level. Known as the "Model 90 Controller," this instrument has been developed to take care of the many requirements for automatic temperature and pressure control that do not warrant a chart record of the controlled temperature or pressure, and also, for applications where recording instruments already are in use. The Model 90 is a small, compact instrument of simple construction, which embodies the latest developments in automatic control. The outstanding feature of this controller is its precision measuring element.

The Model 90 Controller is equipped with a wide-range sensitivity adjustment. It can be changed from direct to reverse acting, or vice versa, by the user without additional parts. The case is moisture, fume, and dust-proof and is offered in two forms,—for wall and for flush panel mounting.

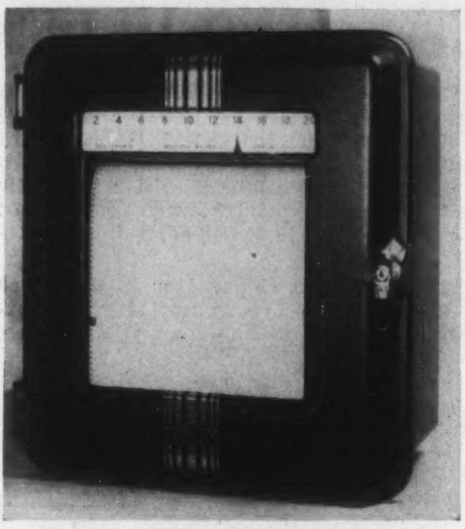


"Smootharc" Welding Electrodes

An entirely new line of coated rods for D. C. welding is now being made and sold through the Harnischfeger Corp. of Milwaukee, manufacturers of P&H-Hansen arc welding equipment. The present line includes five different types with both high and low rates of fluidity for various types of work in welding in flat, vertical or overhead positions and with ferrous and nonferrous metals. Service tests show tensile strength of welds from 55,000 to 75,000 lbs. per sq. in. with various types of rods ranging from 3-32 to ⅜ in. in size. "Smootharc" electrodes are designed primarily to speed up welding operations with a smoother, more easily handled arc and to reduce spatter losses. The new line is described in a new bulletin, No. R-1.

The Silver Anniversary Micromax

The "Silver Anniversary" Micromax recorder, latest and most serviceable of their long line of industrial recording machines, has just been announced by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia. Marking the 25th year since this concern originated the recording potentiometer pyrometer, this Micromax not only provides in the one instrument all combinations of indicating, recording, signalling and controlling, but provides these functions in ways unique to this model. Measurements are presented most conveniently; a bold scale and pointer shows the condition at the moment, and a clear record on ten visible inches of strip-chart shows it for the past several hours. On controllers, a second pointer shows control setting. Multipoint records may be in blue or in multi-color.



In this Micromax, control and signal contacts operate undisturbed by air currents when the door is opened, even when the chart is changed, or the pen refilled. Pen holds seven-week ink supply. An ingenious double frame makes all parts of the mechanism strikingly accessible, and enables the user to replace the chart without effect on other parts of the recorder.

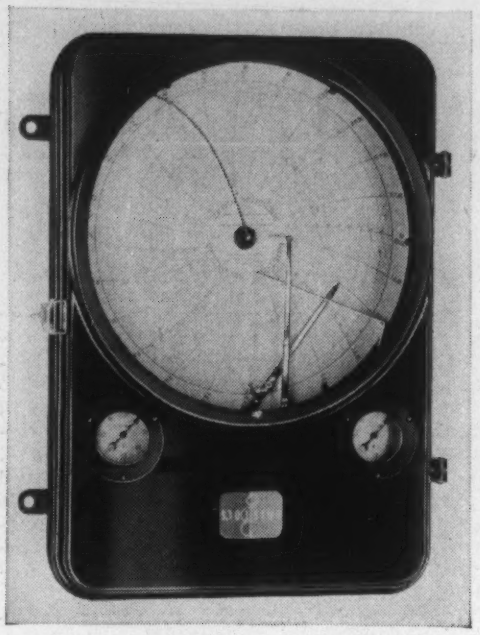
Standard Micromax assemblies assure reliability for the vital operations of measuring, detecting, balancing and control. These assemblies have been improved wherever possible; contacts are heavier, and certain other component parts are new. The machine thus makes available all that is tried and proven in its field; it abandons that which is obsolete and adds new features that make the instrument reliably equal to the needs of modern industry.

New Recorder-Controller with Wide-Range Sensitivity Adjustment

The Bristol Co.. Waterbury, Conn., announces a new series of pneumatic-type controllers known as "Ampliset Free-Vane Controllers." These instruments are now available for automatically controlling temperature, time-temperature, flow, liquid level pressure, time-pressure, and humidity. The Ampliset principle has also been combined with the Metameter, a system of telemetering, recently announced by this company, for the remote control of steam pressure and gas pressure. Bristol's Ampliset Controllers operate on the basic free-vane principle employed by the Bristol company for many years and widely used in industry.

In the Ampliset controller certain features of field adjustability have been added to the time-proved free-vane system, whereby its sensitivity can be changed by means of a small screw driver to exactly fit the lag peculiarities of the process on which it it used. The Ampliset Free-Vane Controller has great versatility. It enables the user to readily adapt it to meet conditions not readily anticipated.

Since the free-vane system is used, which requires practically no power from the measuring element to operate controlling mechanism, the chart record is always accurate. The sensitivity or throttling range of the instrument can be changed without removing the chart or chart dial. It can be changed without, in any way, disturbing the operation of the controller or upsetting the operation or equilibrium of the process. By the same adjustment that regulates the sensitivity of the Ampliset Controller, the instrument can be changed from direct-acting to reverse-acting or vice versa. This change is made by simply turning the scale on the adjustment past the zero point.



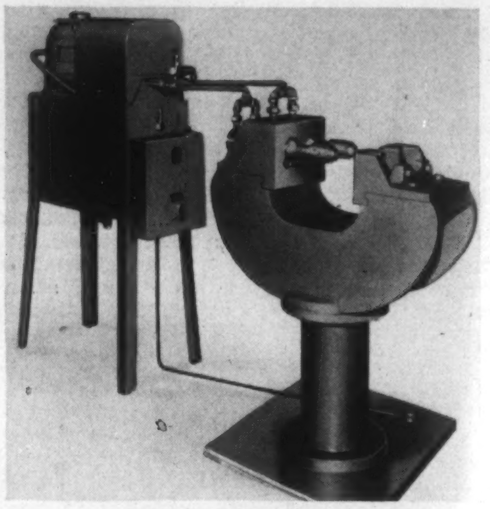
An Industrial Rheostat

The Cooley Electric Furnace Co., of Indianapolis, Ind., announces a new type of industrial rheostat. The rheostat frame is made of cast iron into which is mounted an annular block of refractory material, the same as used in the manufacture of Doreco heating elements. A closely wound resistor coil is embedded in this material. This new and unique material is characterized by the unusual combination of two properties: High dielectric strength and high thermal conductivity. A metal graphite button makes contact with the coil under spring pressure, and affords virtually stepless control of the current within approximately ½ of 1 per cent. The rheostat is simple and rugged and has extraordinary ability to sustain overloads.

New Stationary Riveter

Designed especially for an assembly operation on axle housings, the Hannifin "Hy-Power" hydraulic riveting machine, produced by the Hannifin Mfg. Co., 621 So. Kolmar Ave., Chicago, has duplex hydraulic rams actuated from a new type hydraulic pressure generator unit equipped with automatic electrically operated control valves. A special work holding fixture makes handling extremely simple. Control is by a single foot-switch button, which may be located at any convenient point.

Touching the push button control actuates the hydraulic pump unit and automatic valves, the riveter cycle being completed automatically. The hydraulic ram cycle includes: 1. Rapid advance stroke at moderate pressure, until the die touches the rivet, 2. Automatic high pressure to head the rivet, 3. Reversal at peak pressure, 4. Rapid return stroke to starting position, 5. Oil pump idles at zero pressure between cycles. The riveter ram develops 35,000 lbs. pressure, ample for heading ⅜-in. cold rivets. Equal pressure is applied to head both rivets, regardless of rivet length. The hydraulic pressure generator unit, with automatic valves and control, is driven by a 2-hp. motor and occupies less than 4 sq. ft. of floor space.



This duplex riveting machine is one of several types of high speed units developed for individual production riveting requirements. Other models of Hannifin hydraulic riveters are available in both portable and stationary types and for heading either larger or smaller rivets. The "Hy-Power" hydraulic riveter features of automatic high speed operation, simplified handling, and push button control are exclusive Hannifin developments, and are embodied in the several types of portable and stationary units recently developed.

New Rods for Light Gage Welding Operations

"Thinweld," a specially-coated electrode for arc welding light gage sheet metal, is now offered in 1-16, 3-32 and ⅛ in. sizes by The Hobart Brothers Co., Troy, Ohio. They report that it is in great demand since the introduction of their new 75 and 100 ampere "Simplified" arc welding machines. Among its light welding applications are auto body and fender work; fabrication of heating and air conditioning cabinets, ducts, etc. It is said that some operators have successfully arc welded metal as light as 24 and even 26 gage with the new Hobart models and "Thinweld."

The Core Maker

A new device, called "The Core Maker," has been developed by the Harry W. Dietert Co., Detroit. It is described as the economical way to make cores from unmounted boxes. It will handle all core boxes that are hand stripped.

The Core Maker consists of these major parts—a cast iron base on which is mounted a cast iron table and a vertical plate which is vibrated with either an electric or air vibrator. By a patented connection the vibration does not reach the table on which the cores are stripped. An easily movable vertical guide is mounted on the vertical plate.

The core box may be rammed by hand or by a core blower and then turned over on a core plate, resting on the table of the Core Maker. The core box is pushed against the vertical plate and vertical guide. The vibrator is started by pressing a knee switch. The vertical plate imparts vibration to the core box, which is lifted by hand, using the guide to obtain a perfect lift. Any square cornered metal or wooden core box of single or gang type may be used.

New Flux for Soldering of Aluminum, Cast Iron, etc.

Of interest to solder and flux users is the new flux developed by the Alumaweld Co. of America, 2442 South Park Way, Chicago. This new flux, used in conjunction with a special, high tensile strength solder, is said to do a job heretofore considered impossible.

With "Alumaweld Flux" it is now possible to make high strength, permanent repairs on joints of any metal. It is claimed to make soldering twice as easy because Alumaweld solder and flux is applied with an ordinary soldering iron or blow torch. The soldering job is done at a low temperature but has the advantage of requiring high temperatures to melt it a second time. It works equally well on aluminum, stainles ssteel, die cast pot metal, cast iron, copper, brass, etc., which makes it easy to join any two different metals if desired.

Alumaweld Flux works equally well with any type of solder, but when greater tensile strength is desired, the use of Alumaweld solder is recommended. Alumaweld solder has a tensile strength of 12,000 lbs. which is ten times that of ordinary solder. The finished joint can be worked or machined and takes a polish over which chromium or any other plating can be applied.

Ingot Molds by New Process

Vulcan Mold & Iron Co., Latrobe, Pa., following considerable experimentation and tests, is in process of changing over plant equipment to manufacture its ingot molds by an improved process new to the foundry industry.

The company has secured the United States license to make ingot molds by the cement-bonded sand process known as the "Randupson" process. It is covered by the Durand patents, which are held by the French Societe D'Electro-Chimie D'Electro-Metallurgie et des Acieries Electriques D'Ugine.

Developed especially to remove factors productive of surface defects in the casting, and to promote greater accuracy in size and contour, the Randupson process is represented by the Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., as United States agent for the French compony. For some time, Birdsboro has used the process in its own plant.

The use of the cement-bonded sand process by Vulcan is entailing a complete change-over of its plant facilities, which is being pushed to completion as rapidly as possible. The company expects to be manufacturing its entire output by the new process by mid-July.

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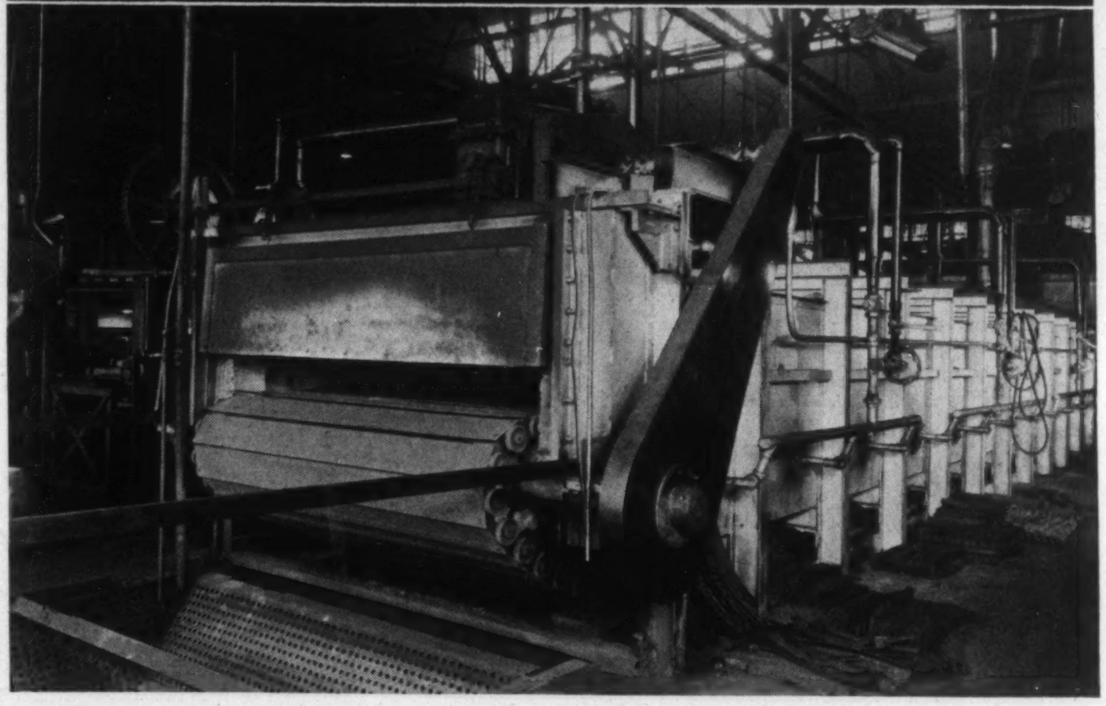

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DESIGNED for a large Detroit manufacturer, the Holcroft gas-fired furnace shown above permits accurate temperature control in making of spring . . . insures uniform quality and a minimum of heating loss. The entire furnace area is constructed of Armstrong's N-20 Insulating Brick laid in 9" thickness and faced with a refractory cement.

Leading furnace designers and plant supervisors standardize on Armstrong's High Temperature Products for successful operating results. In addition to N-20 Insulating Brick, the Armstrong Line includes N-16 Insulating Brick and A-25 Insulating Brick (for temperatures up to 1600° and 2500° F., respectively, behind the refractory), EF-22 Insulating Fire Brick and EF-26 Insulating Fire Brick (for direct exposure). We'll be glad to send samples and complete data on any or all of these brick. Write Armstrong Cork Products Company, Building Materials Division, 982 Concord Street, Lancaster, Pennsylvania.

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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Ore Dressing of Siegerland Copper Deposits (Die Aufbereitung der Siegerländer Kupfererze) H. GLEICHMANN. *Metall und Erz,* Vol. 33, Apr. 1936, pages 193-201. The mineralogic and physico-chemical bases of C ore dressing are discussed. Dry and wet electromagnetic separation methods as well as flotation processes are used. Noble metal concentration and chlorinating-leaching and roasting are described. FPP (1)

Mining in the Rhineland (Untersuchungsarbeiten im rheinischen Erzbergbau) B. ECKERT. *Metall und Erz,* Vol. 33, Jan. 1936, pages 18-21. The location, deposit characteristics, and probable future yield of several ore deposits in the German Rhineland are discussed. FPP (1)

■ 1e. Amalgamation, Cyanidation & Leaching ■

Sulphuric Acid Leaching of Washington Clays for the Production of Alumina and Aluminum Metal. H. C. PARKMAN. *State College of Washington, Metallurgical Research Laboratory,* Bulletin E, Aug. 1, 1935, 51 pages. Al_2O_3 may be extracted from Freeman clay by leaching with 50% H_2SO_4. Roasting is detrimental. Roasting clay with concentrated H_2SO_4 is an efficient method of sulphating the Al_2O_3. The Al_2O_3 produced by evaporating and calcining the $Al_2(SO_4)_3$ solutions formed by leaching acid-roasted Wenatchee clay contained 0.31% Fe, too much for Al electrolytic cells. Crystallization of $Al_2(SO_4)_3$ from the impure leach solution would give a product of sufficient purity for the Al industry. It may be advisable to form alum to get crystals hard enough to be washed free from Fe. The cost of H_2SO_4 extraction of Al_2O_3 is comparable with costs of the Bayer process. AHE (1e)

The Production of Electrolytic Zinc and Vanadic Oxide at Broken Hill, Northern Rhodesia. O. A. E. JACKSON. *Journal Chemical, Metallurgical & Mining Society of South Africa,* Vol. 36, Jan. 1936, pages 173-183; (abstract) *Chemical Trade Journal & Chemical Engineer,* Vol. 98, Mar. 27, 1936, page 262. A mills-Packard plant produces 40 tons of H_2SO_4 daily. Dry ore, containing 25% Zn, is leased without preliminary roasting or concentration. Large amounts of SiO_2 (20 g./l.) are dissolved. Phosphates and vanadates of Fe are precipitated along with SiO_2. The filtrate must be further purified. Ni is very injurious to Zn electrolysis; it is removed by addition of As, Cu and Zn dust. Cl causes dissolution of the Pb anode; it is precipitated by Ag_2SO_4. Cd is removed by Zn dust. The cooled solution is electrolyzed to give a product containing 99.9764% Zn. A 4% V_2O_5 ore is tabled. The 16% concentrate is shipped: the 7% middling is leached, first with very weak acid to remove hemimorphite, then with strong acid to extract V. Neutralization of free acidity with dross (pH 3.00) followed by soda ash additions (pH 5.00) precipitates Cu as a vanadate. The filtrate is acidified and heated in Pb-lined tanks whereby 95% of the H_3VO_4 is precipitated to give a product analyzing V_2O_5 93.5, Cu 0.02, P_2O_5 0.01, ZnO 3.5, Fe_2O_3 1.5, SiO_2 0.2 and other oxides 1.27%. MS + AHE (1e)

The Dissolution of Some Metals in a Solution of Potassium Cyanide. R. HAY. *Journal Royal Technical College,* Vol. 3, Jan. 1936, pages 576-586. The results of experiments on the dissolution of Cu, Al, Ag, Zn, Pb, and Zn-Pb couple in KCN solution are discussed, and it is shown that H is evolved under certain conditions, and the possibility of O functioning as a depolarizer is commented on. The influence of the OH radical upon the pH value of KCN solutions and upon the rate of dissolution of Ag in KCN solution has been determined, and the results have shown that the addition of lime to cyanide solutions does not depend for its beneficial results on the introduction of the OH radical, as the presence of this radical is detrimental to the dissolution of Ag and probably to that of Au. JWD (1e)

The Solubility of Lead Sulfate in Aqueous Solutions of Sulfuric Acid at High Concentrations. H. D. CROCKFORD. *Journal of Physical Chemistry,* Vol. 40, Mar. 1936, pages 303-305. The solubility of Pb-sulphate in various solutions of H_2SO_4 at concentrations over 80% and at 0°, 25°, 35° and 50° C. has been determined. The solid phase at 25°, 35° and 50° C. is always Pb-sulphate. At 0° C. H_2SO_4 and H_2SO_4 monohydrate also exist as solids. EF (1e)

The Cyanidation of Gold-bearing Flotation and Table Concentrate. J. N. BUTLER. *State College of Washington, Metallurgical Research Laboratory,* Bulletin F, Aug. 20, 1935, 48 pages. It is impossible economically to cyanide flotation concentrates which have oxidized between the flotation and cyanide circuits without using some preliminary treatment previous to cyanidation, due to the presence of cyanicides produced by oxidation. A table concentrate is more readily cyanided than a flotation concentrate even though both have stood in air for equal times. A water wash before cyanidation is beneficial; a dilute H_2SO_4 wash is better. Roasting to a dead roast is helpful if temperature conditions are very closely controlled and if Pb is less than 1%. The principles and procedures of cyanidation are reviewed. AHE (1e)

Precipitation of Rare Earths and Thorium with Magnesium Bisulphite. G. P. ALEKSANDROV & YA. P. GOKHSHTEIN. *Redkie Metallui,* Vol. 4, Nov.-Dec. 1935, pages 27-31. In Russian. Th and the rare earths were recovered from minerals by treatment with H_2SO_4 or by chloridization at 600°-700° C., followed by extraction with water. They were then precipitated with $Mg(HSO_3)_2$. From 96-100% of the Th and 80-100% of the rare earths were recovered. HWR (1e)

Milling Practice for Small Gold Mines. C. S. PARSONS. *Transactions Canadian Institute of Mining & Metallurgy,* 1936 (in *Canadian Mining & Metallurgical Bulletin,* No. 286, Feb.), pages 49-51. Discussion. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 109L/10. AHE (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

Some Physical Aspects of Metallurgical Processes (Physikalische Gesichtspunkte bei hüttenmännischen Prozessen) H. WENDEBORN. *Metall und Erz,* Vol. 33, Jan. 1936, pages 45-52; Feb. 1936, pages 70-73. Most smelting operations take place through the action of gases on molten materials partly by chemical and partly by physical mechanisms. Continuous processes examined were those of the shaft-, sintering-, and fines-roasting-furnaces. Discontinuous processes include most melting operations performed in reverberatory and rotating furnaces; with substances with low melting point, heat transfer occurs chiefly by convection, while with higher melting materials heat transfer occurs primarily by conduction. The fusibility of the metal depends on its external form as well as on specific properties such as thermal conductivity and heat content at the melting temperature. Comparison of short and long drum type furnaces shows that substances melting in the lower and middle temperature ranges do so more rapidly in the short than in the long furnace, whereas difficultly fusible materials are more rapidly melted in the long furnace. FPP (2)

■ 2a. Non-Ferrous ■

A Survey of the Aluminum Industry and Its Metallurgical Processes, with Reference to the Utilization of Northwest Clays. R. M. MILLER. *State College of Washington, Metallurgical Research Laboratory,* Bulletin D, July 15, 1935, 71 pages. A review. AHE (2a)

The Rhokana Electrolytic Copper Refinery. ARCHER E. WHEELER & HENRY Y EAGLE. *Bulletin, Institution of Mining & Metallurgy,* No. 379, Apr. 1936, 19 pages. Nkana blister Cu is of exceptional purity with a precious metal content (Au 0.02 and Ag 2.22 oz./ton) too low to justify electrolytic refining simply to recover these values. However, Bi content is too high (0.0093%) to permit making highest quality Cu by fire-refining methods only. The new refinery, consisting of an anode department, an electrolytic tank house, and a furnace refinery, is described. AHE (2a)

■ 2b. Ferrous ■

Influence of Weather Conditions on Blast Furnace Practice (Einfluss der Witterungsverhältnisse auf den Hochofenbetrieb) K. GUTHMANN. *Stahl und Eisen,* Vol. 56, Mar. 5, 1936, pages 293-297. Rainfall causes a decrease in the dust. Composition and heat content of the blast furnace gas changed with the humidity and moisture in the charge. Increased humidity lowered production and raised fuel costs. SE (2b)

The Physical-Chemical Bases of the Mixing of Iron Ores. Part III (Die physikalisch-chemischen Grundlagen der Möllerung von Eisenerzen. Teil III) J. KLÄRDING. *Archiv für das Eisenhüttenwesen,* Vol. 9, Sept. 1935, pages 127-129. In the reduction of mixes of FeO, Al_2O_3, and SiO_2, the sillimanite is the least stable of the possible compounds of these oxides. Al_2O_3 and SiO_2 are slagged by FeO. In the presence of SiO_2 and Al_2O_3, maximum reduction of FeO and easiest slagging of the refractory oxides lies at $3\,CaO \cdot SiO_2 \cdot Al_2O_3$. SE (2b)

Reduction Conditions with Experiments on Prereduced Sinter in a Charcoal Blast Furnace at Sandviken (Undersökningar beträffande reduktionens förlopp samt försök med forreducerad sinter vid Sanvikens masugn nr 3). MARTIN WIBERG. *Jernkontorets Annaler,* Vol. 119, Dec. 1935, pages 499-548. When pig Fe with 1.31% Si and 1.51% Mn was produced from sinter with 55% Fe, the consumption of charcoal was 50 hl. (715 kg. dry charcoal) per 1000 kg. pig Fe. The temperature of the blast was 375° C. and the CO_2-content of the blast-furnace gas 13.4%. The velocity of the gas was highest near the wall of the furnace, where the main part of the ore was passing down. Indirect reduction started at 500° C. Above 700° C., the CO_2-content of the gas was higher than that corresponding to the equilibrium $CO_2 + C = 2CO$. The direct reduction started at 750° C. and reached its highest intensity at 750-1000° C. At 1000-1100° C. the sinter was in the main reduced to Fe sponge. No deposition of C occurred in the upper part of the furnace. Most of the H in the charcoal was driven out between 700 and 900° C. Below 900° C. the content of water vapour in the gas was higher than that corresponding to equilibrium for the water gas reaction. H_2O and CO therefore may react in the upper part of the furnace, forming H_2 and CO_2. The moisture in the gas counteracts the reducing action of H in the upper part of the furnace. During a period of 2 weeks one of the Sandviken furnaces was operated with prereduced sinter with a composition between FeO and Fe_3O_4 (degree of oxidation = 78%). The sinter was reduced in a continuous shaft furnace by means of cold blast-furnace gas, the sinter first being heated to 1000° C. in the upper part of the shaft by burning the gas. The original sinter consisted principally of Fe_2O_3. No metallic Fe was obtained and no deposition of C took place during the reduction. When this prereduced sinter was used in the blast-furnace, the CO_2-content of the gas decreased from 13.5 to 9.4%. This change was greater than would be expected from the decrease of the O content of the charge and an increase in the charcoal consumption of 2.9 hl. (40 kg. dry charcoal) per ton pig Fe was thus obtained. Also in this case there was no deposition of C in the furnace. The reduction did not start until 720° C. At higher temperatures the prereduced sinter was less easily reduced. This was probably because ordinary sinter is easily disintegrated after prereduction at low temperature in the blast-furnace, the reacting surface thus being considerably increased. Sinter which was prereduced at a high temperature in a special furnace remained hard in the blast-furnace. When both kinds of sinter were reduced with charcoal powder in a box, no difference in reducibility was found. HCD (2b)

3. MELTING, REFINING AND CASTING

Questal Bentonite [Bond for Moulding Sand]. J. N. Wilson. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, pages 315-317. Extracted from booklet by Quest Products Ltd., Cheshire. By incorporating "Bentonite," a colloidal bond material, in silica sand, a molding sand having high permeability, high strength both green and dry, and needing the minimum amount of added water, is obtained. JCC (3)

3a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

The Castability of Aluminum Alloys. Investigations with the Spiral Mold. A. von Zeerleder. *Metal Industry,* London, Vol. 47, Nov. 29, 1935, pages 531-534, 540. The requirements for a suitable casting alloy are indicated. The author then gives, in brief, the history of the study of castability and describes, in general, some of the types of molds that have been used. The method and equipment developed by Portevin and Courty are described in detail. Results of experiments using this method with pure Al, Anticorodal (A.W. 160) with 2% Si, 0.6% Mn and 0.6% Mg, Anticorodal with 5% Si, 0.6% Mn and 0.6% Mg, and Silumin with 13% Si are discussed. Applications of the use of the spiral mold and the effect of the solidification range are considered. 11 references. HBG (3a)

Casting and Shaping (Giessen und Gestalten) O. Summa. *Aluminium,* Vol. 18, Apr. 1936, pages 135-138. In general, wall thickness for sand castings should be, if possible, more than 3 mm., for chill mold castings 3 mm. and for die castings it can be less than 3 mm. Transitions of wall thicknesses should have a radius of 4, 3 and 1 mm. respectively for the same type of castings. Examples illustrate a few very complicated ribbed castings and the arrangement of pattern and mold to obtain a uniformly dense material. Ha (3a)

Foundry Practice for Large Non-Ferrous Castings. M. C. Oldham. *Metal Industry,* London, Vol. 47, Nov. 15, 1935, pages 483-486. The author refers to the diversity and complexity of non-ferrous alloys in any foundry which must deal with a wide range of engineering requirements. He cites Mn-bronzes, various brasses, phosphor-bronzes, gun metals, Al alloys of different types, Si brasses, etc. He comments upon the problem of mixed scrap and states that the real foundry problems deal with metallurgical and associated subjects. Problems considered are temperature control, furnace atmosphere, effect of variations in the freezing range, temperature uniformity in large castings, and molding practice for Mn-bronze castings. A method to avoid entrapment of ZnO in castings is suggested. HBG (3a)

The Solubility of Hydrogen in Molten Aluminium. L. L. Bircumshaw. *Transactions Faraday Society,* Vol. 31, Oct. 1935, pages 1439-1443. The solubility of H_2 in molten Al was determined at 700°, 800°, 900° and 1,000° C. and the volumes (N.T.P.) of gas dissolved were found to be 0.23, 0.89, 1.87, 3.86 cc./100 g. of metal respectively. The "saturated" heat of solution was calculated to be 43,400 cal./g. of gas dissolved. 6 references. PRK (3a)

3b. Ferrous

C. H. HERTY, SECTION EDITOR

Metallurgy of Crucible Steel Making (Zur Metallurgie der Tiegelstahlerzeugung) O. Meyer, W. Eilender & A. Walz. *Archiv für das Eisenhüttenwesen,* Vol. 9, Apr. 1936, pages 475-481. The metallurgical reactions in the crucible melting of 0.85% C steel were observed, the reactions of C, Si, Mn, O_2, and N_2 being followed. A vigorous boil improves the quality of the steel, the boil occurring by the reaction of C with SiO_2 of the crucible; there is practically no reduction of Si from the slag. In normal melting an equilibrium between the bath, crucible, and slag should be attained, whereby the slag remains constant in composition. SE (3b)

Influence of Carbon on Steel Making Reactions (Ueber den Einfluss des Kohlenstoffs auf den Ablauf der Stahlerzeugungsverfahren) F. Körber, W. Oelsen, G. Thanheiser & P. Bardenheuer. *Stahl und Eisen,* Vol. 56, Feb. 13, 1936, pages 181-208. A summary report of the extensive studies by the Kaiser-Wilhelm-Institut für Eisenforschung, in 3 parts. I. *The Essentials of Carbon Removal.* The reactions of C in the bath with the oxides in the slag and bath to form CO are discussed. This reaction, resulting in a C drop, is governed by external factors favoring the formation of CO bubbles in the bath, surface effects etc., as well as by the relatively simple chemical equilibria. Under certain conditions (these results were obtained in laboratory crucible melts) an unreactive bath is obtained even in the presence of C and oxides, so that no C drop occurs. CO bubbles generally do not begin to form within the bath or at the contact surface with the molten slag, but only at the contact surface with a solid, such as the walls of the crucible. A vigorous boil does not necessarily signify a high oxide content of the bath; more likely it indicates high reactivity of the C which results in bringing the O_2 content of the bath down to lower values than would be in equilibrium with the oxide content of the slag. II. *Carbon in the Acid Open-Hearth Process.* The changes in composition of the bath and slag of five 30-ton acid open-hearth heats were observed. In all of these a considerable amount of Si was reduced into the bath, C exerting a strong reducing action. Because of this strong reducing action of C, the O_2 in the bath was removed at a faster rate than it could be replenished from the slag or furnace lining to reach the equilibrium value for O_2 in bath vs. oxides in slag. The lower layer of the slag directly in contact with the bath is impoverished in FeO and MnO and enriched in SiO_2, so that this layer becomes very viscous, almost solid. The Si content of the bath rises above the equilibrium value for SiO_2 in the slag, and the reaction between bath and slag is largely inhibited. For this reason the reduction of Si determines the rate of C drop at the end of the heat. III. *Carbon in the Basic Open-Hearth Process.* The changes in composition of the bath and slag of eight 30 and 60-ton basic open-hearth heats were observed, special attention being paid to the reaction between C and O_2. For higher C contents and temperatures these react very rapidly. So long as about 0.2% C is present and this behaves reactively, the O_2 content of the bath is determined by the C content. When the C content falls below this value, however, the O_2 content of the bath is determined by the FeO in the slag. Low concentrations of C or O_2, low temperature, and a viscous slag inhibit the reaction of C with O_2. The Mn content of the bath or the MnO content of the slag govern the FeO content of the slag, and thereby the rate of the C reaction. A high Mn content prevents an undue rise in the O_2 content of a low-C bath. The reduction of Mn out of the slag is a sure sign of a lowering of the O_2 content of the bath by means of C; the more Mn is reduced from the slag, the less need there is for final deoxidation. There is a lively discussion between Schenck and the authors on the following questions among others. Does the partition of O_2 between slag and bath approach equilibrium? Does the rate of C drop always depend on the C and O_2 content of the bath? Does the O_2 content of the bath depend on the FeO in the slag or the C content of the bath? Does a slow or fast rate of C drop give a lower O_2 content of the bath? SE (3b)

Investigation Shows Actual Cupola Melting Loss and Gain. J. A. Lannigan. *Foundry,* Vol. 64, Jan. 1936, pages 34, 72. Describes tests conducted to determine actual cupola melting loss or gain. Each of 7 heats was made up of one class of material only. The C pickup or gain in steel minus total of pig and scrap left a net gain of 1.0%. Fe lost in emlting was as follows:

50% machine cast pig	..........known melting loss	—negligible
25% No. 1 machinery scrap	..........known melting loss	— 0.65
25% steel scrap	....known melting gain (due to C pickup)	— 1.65
	Total gain........	1.00

VSP (3b)

Broken Hill Steelworks in Australia. F. C. Elsworth. *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, pages 305-307. Brief illustrated description of plant of the Broken Hill Proprietary Company, Ltd. Fe-ore is mined at "Iron Monarch" in South Australia, limestone is obtained in Tasmania, and coal from mines near the works in Newcastle, N.S.W. Includes 3 blast-furnaces with a capacity of 700,000 tons of pig-Fe; 10 basic open-furnaces varying in capacity from 80 to 130 tons; 35" blooming-mill; 90" plate-mill; foundry; pipe mill; and by-products plant. MS (3b)

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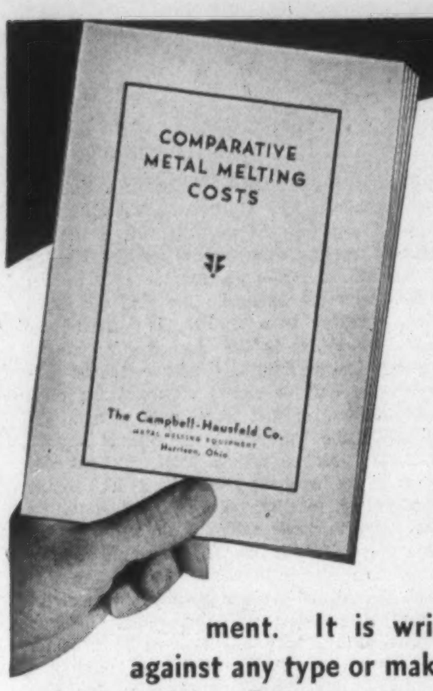

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Formed Tubes Cast in Gray Iron. *Foundry,* Vol. 64, Jan. 1936, pages 35, 75. Describes the casting of formed tubes for use as electric immersion heaters inside of protective coating of gray Fe by the Cleveland works of Westinghouse Electric & Mfg. Co. Metal straps welded to tubes hold them in place while mold is filling with molten Fe. A metal block serves double purpose of holding all ends of tubes in proper position and forming a chill to protect open end of tubes and metal from shorting tube and resistance wire. Tubes are sandblasted, dipped in Al paint and dried for 30 min. Moisture is removed by heating in oven to 400° F. for an hr. Tubes are set in mold and metal poured quickly. Fe at 2450°-2500° F. gives best results. 8 gates are used. VSP (3b)

Ford Casts Parts of Alloy Iron and Steel. *Foundry,* Vol. 64, Feb. 1936, pages 26-27, 70. Most recent improvements at the plant of Ford Motor Co. are: (1) 36″ water line from power house to rolling mill; (2) Hot strip mill completely equipped; (3) New blooming mill; (4) Cold finishing mill; (5) Ingot stripper; (6) Reconstruction of blast furnace to increase capacity from 600 to 800 tons daily; (7) Modernization of main power house; and (8) Alloy steel casting department in foundry. Although alloy steels of various compositions are used for many automobile engine parts, cast Fe is still the most satisfactory for cylinder blocks. The composition of this Fe is: Total C 3.20-3.40%; Si 1.90 = 2.10%; S 0.10 max.; P 0.25-0.32%; Mn 0.60-0.80%; Cu 0.75%. The analyses of various alloy Fe castings for crankshafts, cylinders, insert rings and valves are tabulated. VSP (3b)

Manufacture and Qualities of Wrought Iron. E. W. KAVANAGH. *Proceedings Southern & Southwestern Railway Club,* Vol. 23, Jan. 1936, pages 8-30. Definition of wrought Fe as made in the puddling process, the chemistry of the latter as represented principally by the reactions (1) $Fe_2O_3 + 3C = 3CO + 2Fe$ and (2) $CO + O = CO_2$ and the treatment of the puddled Fe are described. Ha (3b)

Reactions of Chromium with Acid Slags (Die Reaktionen des Chroms mit sauren Schlacken) F. KÖRBER & W. OELSEN. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 17, No. 21, 1935, pages 231-245. The behavior of Cr in solution in the molten Fe against ferrous oxide-manganous oxide-silicates in presence of solid silicic oxide were studied in order to determine the reactions of Cr with basic slags in steel production. It can be stated that the equilibrium conditions of the reactions of Fe, Mn and Si with their oxides are only slightly changed in the presence of Cr in the metal layer and in the slag layer. The slagging of Cr, i.e. the ratio $(\Sigma Cr)_{slag} : Cr_{metal}$ depends largely on the composition of the steel melt and of the silicate slag; this ratio increases strongly with increasing ferrous oxide content of the slag. Higher Mn and Si contents of the steel melts result in a lower ferrous oxide content of the slag and of the melt and in this manner counteract the oxidation of Cr. Compared with Mn and Si, Cr is a very weak reducing agent so that its deoxidizing effect in the deoxidizing of Cr-containing Fe by Mn and Si is low. Cr occurs in acid slags and in the silicate inclusions of Cr steels in part as Cr_2O_3, mainly as CrO as long as slags and inclusions are still liquid. When the slags crystallize the chromous oxide largely disintegrates to chromic oxide and metal. 16 references. Ha (3b)

Simple Facts About Common Steels. J. R. MILLER. *Heat Treating & Forging,* Vol. 22, Mar. 1936, pages 129-131. Discusses deoxidation of steel, inclusions, and making, handling, and heating of ingots, to show their effect on quality of steel. Well melted steel can be very badly injured, and poorly melted steel may be materially improved, according as deoxidizing, teeming, handling, stripping, and soaking are poorly or well done. Steel, well made up to ingot form, is very hard to spoil except by grossly careless stripping, soaking, and rolling. MS (3b)

Heat Losses in the Bessemer Converter. M. PASCHKE & E. PEETZ. *Iron & Coal Trades Review,* Vol. 132, Mar. 13, 1936, pages 487-488. The report of Verein deutscher Eisenhüttenleute in Stahl und Eisen is given in full with curves and charts. Ha (3b)

Steel Castings are Produced in Molds Bonded with Cement. PAT DWYER. *Foundry,* Vol. 63, Dec. 1935, pages 22-24, 60; Vol. 64, Jan. 1936, pages 30-32, 68, 70; Feb. 1936, pages 28-30, 72, 74, 77; Mar. 1936, pages 30-32, 71-72. Describes the Randupson process for making molds for steel castings used by the Birdsboro Steel Foundry & Machine Co. Nearly all classes of castings are made by this process, ranging in wt. from a few lb. to 50 tons. In this method new silica sand is bonded with cement in proportions dependent upon type of casting to be produced. Advantages claimed are that castings conform accurately to size and shape of pattern and no ovens are needed to dry molds. Rods, arbors or other reinforcements are greatly reduced by use of molds and cores from cement bonded sand. The process lends itself readily to construction of cores. Illustrates successive steps in production of a sand-cement core for a bent pipe 11′ long and 22″ inside diam. Concludes with a brief history of the company. VSP (3b)

Used Dry Sand Runner Boxes to Eliminate Dirt in Iron Castings. T. H. BEAULAC. *Foundry,* Vol. 63, Dec. 1935, page 35. Castings for air compressors, oil and gas engines, diesel engines, etc. are cast in dry sand. Consequently molds taken from ovens are very hot, and while green sand runners are built, they become dried out and crumbly. Dry sand runner box is used on castings up to 1 ton. Describes method of procedure. VSP (3b)

Castings Support Steel Cables. W. A. BECK. *Foundry,* Vol. 63, Dec. 1935, pages 32, 74. Briefly describes the casting of cable supports for the Golden Gate Bridge by the Bethlehem Steel Corporation. Plain C steel, melted in open-hearth furnaces, was poured into pit molds arranged for bottom pouring. Each casting was fed by 9 risers. Afterwards castings were annealed to remove internal strains and rough machined. Finishing was done at another plant. Each support consisted of 3 segments bolted together. Combined wt. of each unit was about 150 tons. Maximum metal thickness was 7″. VSP (3b)

Iron Content of Basic-Bessemer Slags for Various Lengths of Blow (Eisengehalt der Thomasschlacke bei verschiedenen Blasezeiten) O. SCHEIBLICH. *Stahl und Eisen,* Vol. 56, Apr. 30, 1936, pages 505-512. Under otherwise comparable conditions increasing the time of the blow did not increase the Fe content of the slag. Variations in the latter were obtained for very short blows, probably because of temperature fluctuations. SE (3b)

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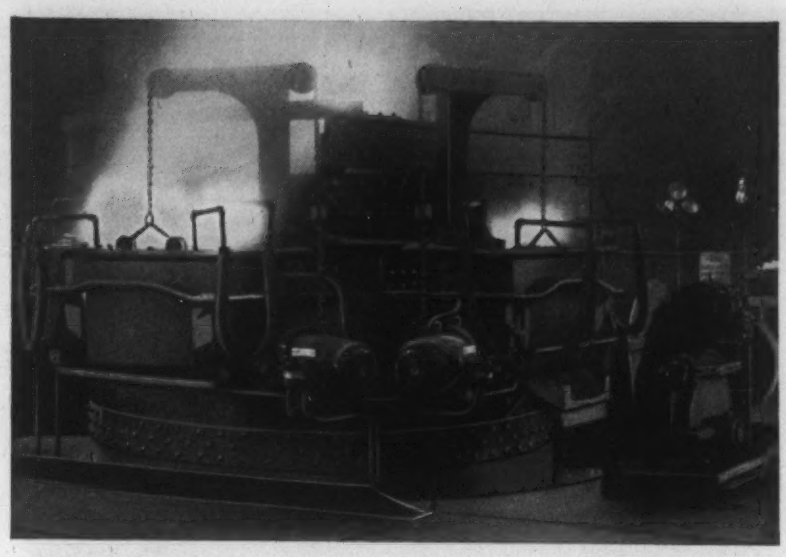

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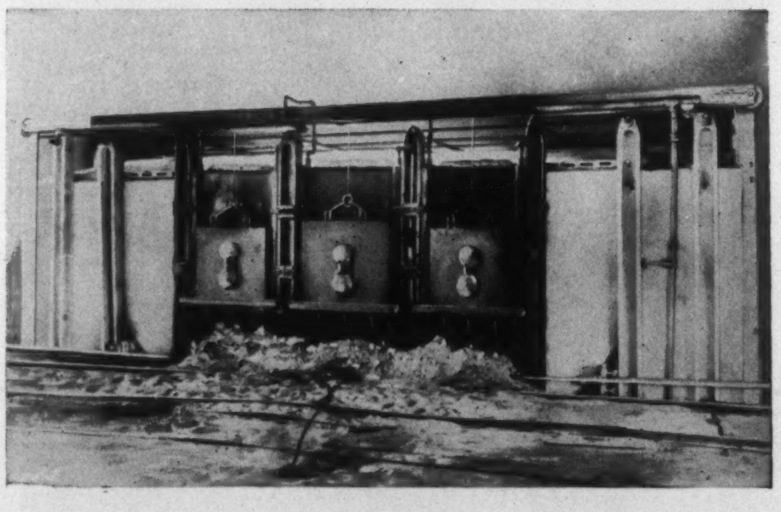

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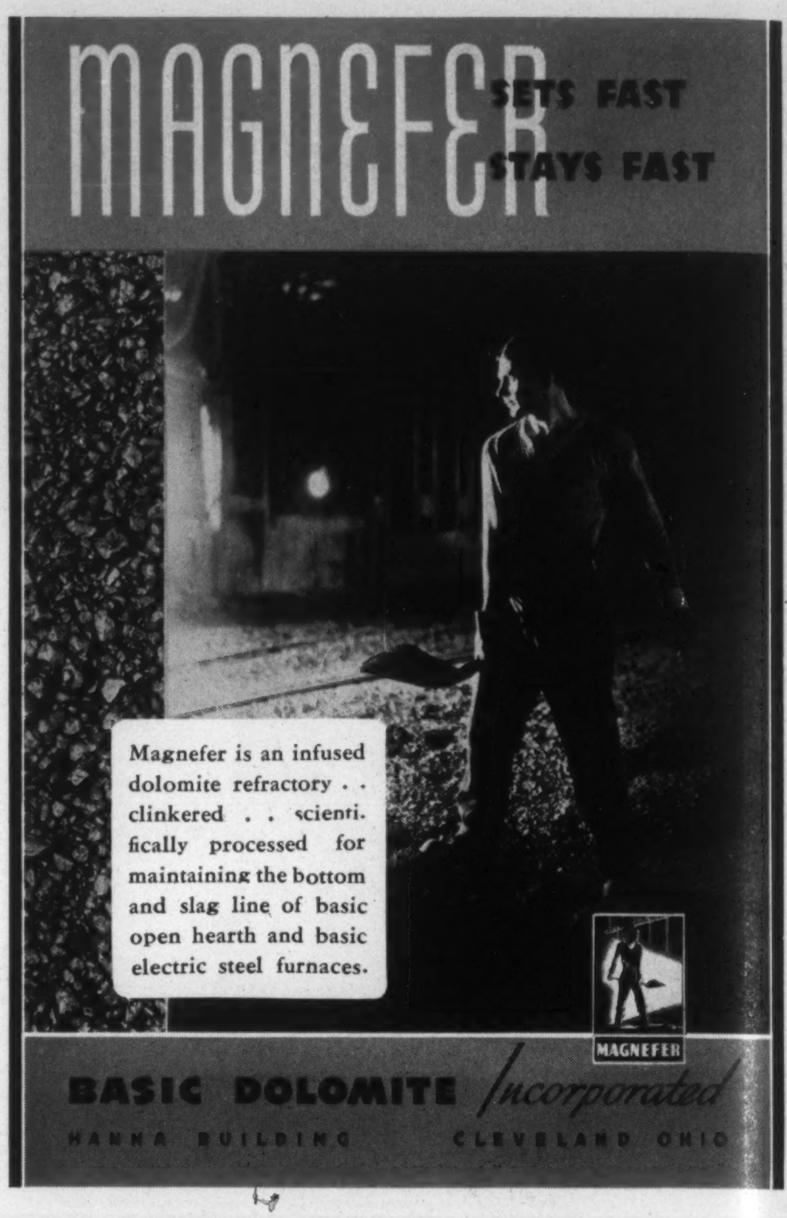

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Distribution of Phosphorus Between Steel and Slag. E. MAURER & W. BISCHOF. *Metal Progress,* Vol. 29, Jan. 1936, pages 48, 70. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 6L/1. WLC (3b)

High Chromium Alloys—Centrifugal Castings and Tubes. R. J. WILCOX. *Metal Progress,* Vol. 29, Jan. 1936, pages 44-48. Molds are prepared by ramming sand around a pattern carefully centered in a flask and drying it in a vertical position at uniform temperature. Flask containing sand mold is locked in the machine, pouring spout placed and rotation started. Speed of rotation is selected for the thickness and length of casting. Metal to form desired wall is accurately measured and poured into the spinning mold. Concentricity is obtained by accurate centering of pattern and balance of the rotating parts. Uniformity of longitudinal section depends upon fluidity and centrifugal force. It is obtained by length limitation and proper speed selection. Ratio of wall thickness to length is limited by fluidity. These limits for 18-8 and 29-9 stainless are 9′ length with wall of 5/16″ and diam. up to 12″; for the 35-15 type 1/8″ wall is obtainable in longer lengths. Tubes form quickly. Uniform distribution of metal is achieved in approx. 7 sec. and complete solidification in 60-90 sec. for a 9′ tube with 5/16″ wall and 8″ diam. Applications of such tubes are discussed. WLC (3b)

German Open-Hearth Practice with Coke Oven Gas (Betriebsergebnisse deutscher Siemens-Martin-Oefen mit Koksofengasbeheizung) B. VON SOTHEN. *Stahl und Eisen,* Vol. 56, Mar. 12, 1936, pages 321-328; Mar. 19, 1936, pages 351-362. An extensive study of the properties and relative advantages of cokeoven, producer, and mixed gas. SE (3b)

Now—Cast Iron Die Castings! CHAS O. HERB. *Machinery,* N. Y., Vol. 42, May 1936, pages 569-574. A method developed by Weatherill for die casting cast Fe is described. The molten metal is forced into the dies at 20 lbs./in.^{2}, the dies are made of ordinary cast Fe lined with cold rolled steel that fits the shape of the pieces to be cast. Die castings have the same chemical analysis as sand castings, but have considerably better physical properties, as they have a close-grained, uniform structure throughout. Equipment used and examples are described. Ha (3b)

Studies of Basic Bessemer Practice (Betriebsuntersuchungen über den Frischverlauf in der Thomasbirne) W. BADING. *Stahl und Eisen,* Vol. 56, Apr. 2, 1936, pages 409-416. A sampling mold suspended above the converter was lowered into it several times during the blow to obtain metal and slag samples. In this way the refining reactions during the blow were studied. Curves of the changes in composition of the bath and slag are shown. SE (3b)

Sixth Report on the Heterogeneity of Steel Ingots. *Iron & Steel Institute,* Special Report No. 9A, May 1936, 70 pages. Discussion, correspondence and Committee's reply to Report No. 9. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 4L/1. JLG (3b)

4. WORKING

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Spreading During Rolling with Varying Rolling Speeds and Steel Compositions (Das Breiten beim Walzen bei verschiedenen Walzgeschwindigkeiten und Stahlzusammensetzungen) A. Spenlé. *Stahl und Eisen,* Vol. 56, May 7, 1936, pages 544-549. Rolling C steels at varying speeds indicated that the rolling speed should be kept within certain limits for the variations in width not to exceed the specification. The addition of various alloying elements tended to increase the departure from the specified width. SE (4a)

Production Supervision in a Billet and Rail Mill (Leistungsüberwachung einer Block- und Schienenstrasse) K. Skroch. *Stahl und Eisen,* Vol. 56, Jan. 2, 1936, pages 10-14. Time studies were made and the soaking pits found to be the bottle-necks. SE (4a)

Some Considerations Influencing Plant Facilities for Strip-sheet Production Under British Conditions. Geo. A. V. Russell. *Iron & Steel Institute,* Advance Copy No. 13, May 1936, 19 pages. The commercial possibilities of wide-strip mills in England are considered. Comparison of British and American conditions lead the author to conclude that smaller productive units are desirable in England. 3 designs of wide-strip mill plants of different capacities and product ranges are shown as being applicable to British conditions. JLG (4a)

A New Strip and Band Steel Rolling Mill (Ein neues Streifen- und Bandstahl-Walzwerk) G. B. Lobkowitz. *Stahl und Eisen,* Vol. 56, May 14, 1936, pages 571-574. A new mill for rolling band and strip steel 15 to 400 mm. wide, 0.8 to 2.75 mm. thick and up to 120 m. long is described. SE (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Forming and Forging in 1935. F. L. Prentiss. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 309-312; Jan. 9, 1936, pages 36-39, 86. Progress in forging industry consisted in improvement in quality and accuracy of product, in development of more efficient equipment, in technical advancement and in lowering of production costs. Sizing to shape on accurate coining presses to reduce machining became more general. Hammer forgings are held to tolerances of 0.008" or less and these are reduced to 0.005" or less on coining presses. Extrusion has become more general particularly for gear forgings. No important advances were made in cold forging. Forging furnaces and billet heating have advanced. Improved methods of deoxidizing steel in melting and closer temperature control in casting have improved die steels. Inspection of dies and die steels is more stringent. VSP (4b)

Handling and Heating Heavy Ingots. Ronald Benson. *Mechanical Handling,* Vol. 23, Mar. 1936, pages 67-69. Abstract of paper "The Technique of Forging," read before the Manchester Association of Engineers. JCC (4b)

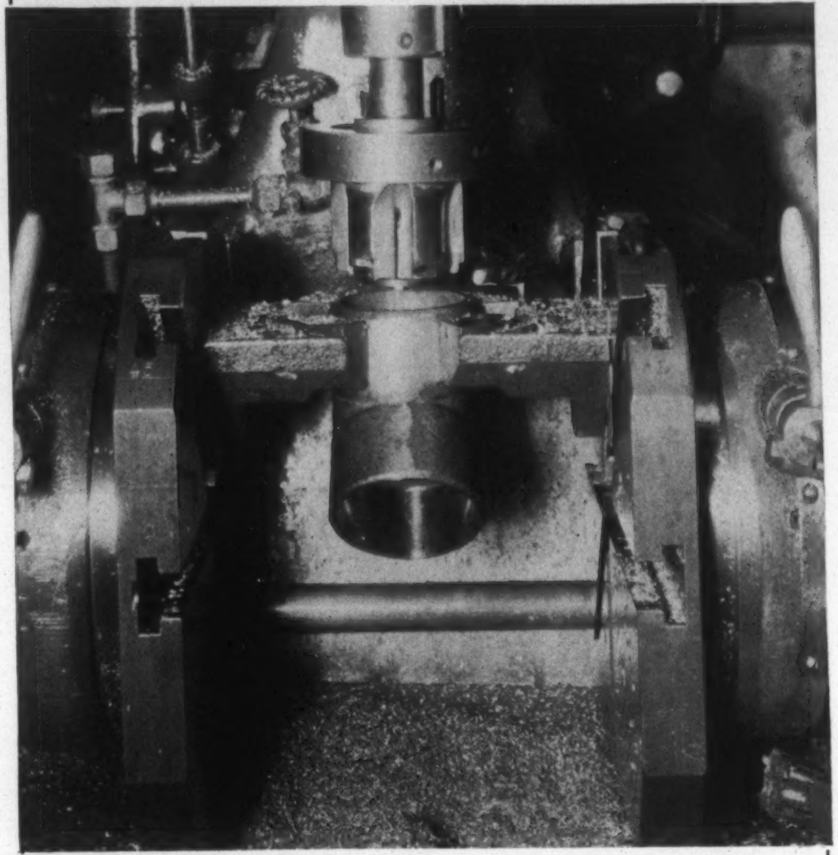
4c. Cold Working, including Shearing, Punching, Drawing & Stamping

Hot-Pressed Light-Metal Parts (Warmgepresste Leichtmetallteile) Reichenbach. *Aluminium,* Vol. 18, Mar. 1936, pages 100-102. Al and its alloys with Mn, Si, Mg-Mn, Mg-Si and Cu-Mg are very suitable for manufacturing parts by hot-pressing. A table shows the mechanical properties and test results; while Brinell hardness of cast and hard-pressed materials were about the same, tensile strength and elongation were much superior for the pressed parts, and the structure is more uniform and dense than in a cast piece. Ha (4c)

Effect of Annealing on Release of Internal Stress in Cold-drawn Rods. Kisuke Saito. *Kinzoku no Kenkyu,* Vol. 12, Dec. 1935, pages 551-558. In Japanese. The effects of annealing on the release of internal stress and the hardness change in cold-drawn rods were studied. 7 kinds of metals, i.e., Cu, brasses (70 : 30 and 60 : 40), Armco Fe and steels containing 0.3, 0.8 and 1.3% C were used for the present investigation. The release of internal stress was inferred from the change of length of the rod, measured in the direction of drawing under room temperature, to which the specimen was cooled down slowly in a furnace after the annealing at different temperatures for half an hour; the annealing was repeated at successively high temperatures. In general, the length of the rod contracts in the case of Cu and brasses in the whole range of annealing temperature, but in the case of iron and steels, it elongates in a certain range of temperature and afterwards contracts. The amount of the change of length of the rod in the former case is smaller than in the latter case. The temperatures, at which the internal stress is released, are about 300° for Cu, 370° for brasses and 650° for Fe and steels respectively, and the increased hardness due to cold-working is reduced to its original value in the vicinity of these temperatures. KT (4c)

Drawing of Stainless Steel (Etirage de l'acier inoxydable) L. Roy. *Métaux,* Vol. 10, Dec. 1935, pages 299-302. General discussion on forming of stainless steel sheets. GTM (4c)

Cut Manufacturing Costs . . . In Half



FIRTHITE on this operation is used to bore and face cast-brass pipe elbows. The cutter head has seven inserted-type blades —six that finish the bore to size, and one mounted in an adjustable sleeve, that faces and forms the edge—all FIRTHITE tipped. The cutter operates at 400 feet per minute, produces up to 5000 pieces between tool grinds and offers a total life of more than 80,000 pieces.

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Distribution of Internal Shearing Stress in Many Twisted Metallic Rods and Their Changes Due to Annealing. Tarô Uêda. *Kinzoku no Kenkyu,* Vol. 13, Jan. 1936, pages 1-19. In Japanese. Measurement of elastic after-effect was made on Armco Fe, C steels (0.2, 0.4, 0.6, 0.7, 0.9, 1.1, 1.3% C), Cu and Mg, to all of which twisting deformation was previously applied. In C steels a eutectoid steel having 0.89% C showed the highest elastic after-effect. The time required to attain an equilibrium condition of this sample was about 70 hours, but with other samples, was not longer than 40 hours. The distribution of internal shearing stress in the cross-section of specimens which attained the equilibrium condition was also measured. In the exterior of specimen bar the internal shearing stress acts in such a direction that the given twisting deformation might be advanced, while in the interior it acts in the direction of recovery. The twisting moment thus produced on the periphery of the center by these 2 kinds of internal stress bearing opposite sign is equivalent in magnitude but is in opposite direction, and hence they maintain mutually an equilibrium condition. Since internal stress was found to be distributed in the interior of sample bar which was given twisting deformation, the decrease of the stress due to annealing at various temperatures was studied. It was found that a large portion of the stress disappeared in the range of temperatures 300°-500° C. in the case of Fe and C steels, 100°-400° in the case of Cu, and 50°-200° in the case of Mg. The change of microstructure due to variation in temperature at a fixed position in Armco Fe which was given twisting deformation by the amount to 0.2 π/cm. was studied. In order to examine the changes in property due to variation in temperature, specific gravity and surface hardness (by a Vicker's hardness tester) of some metals were also measured. The results were found to agree satisfactorily with each other. As the internal stress decreases during annealing, it was studied by measuring the change of deformation of 15 kinds of metal heated under a fixed rate in vacuum. The change of deformation observed in this experiment was attributed to the recrystallization as well as to the growth of grains. Latent energy due to the presence of internal stress was also measured; it was about 0.2% of the applied energy in the case of 0.9% C steel, 0.12% in the case of 1.3% C steel, 0.18% in the case of Mg, and still less in the case of other metals.
KT (4c)

■ 4d. Machining ■

H. W. GRAHAM, SECTION EDITOR

Efficient Hand Filing. *Mill & Factory,* Vol. 18, Apr. 1936, pages 47-51, 129-132. In spite of great precision advances in machine tool development, hand filing is still an important operation. Files are classified according to their suitability for dividing, shaping and cleaning, and a complete check list for selection, application, maintenance and disposition of files is given. Technique of filing varies with nature and condition of the metal to be cut as well as with the particular cutting job required. Routing of files during their life is described and advantages and disadvantages of resharpening are cited.
FPP (4d)

Getting Results with Sintered Carbides. Frank W. Curtis. *Modern Machine Shop,* Vol. 8, May 1936, pages 48-60. Principles to be observed in the use of carbide tools, their shapes as dependent on material to be machined and manner of support are explained in detail.
Ha (4d)

Factors Influencing the Nature of the Cutting Speed-Tool Life Curve. O. W. Boston, W. W. Gilbert & C. E. Kraus. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 186-212. Paper and discussion from the Chicago Convention of the Society, 1935. Data presented show that the slope and vertical position of log cutting speed-log tool life curve will be changed by change of tool shape, change of brand of steel, analysis or treatment of material cut. Cutting fluids produce characteristic curves. Results differ between shallow thick cut and deep thin cut. Fluids cause the log curve to be steeper on shallow thick cut and flatter on deep thin cut. Data are presented on the merits of several cutting fluids.
WLC (4d)

Some Factors Affecting the Machinability of Steels and Other Alloys. *Metal Progress,* Vol. 29, Jan. 1936, pages 31-34. Discussion at meeting of Cleveland Chapter A.S.M. A low ductility and low strength tend to make machining easy. Low ductility (proper degree of dynamic brittleness) prevents the chip from clinging to the stock of balling up on the tool. Low strength makes for less power in separating the metal. A discontinuous structure makes for good machinability, a single phase matrix is improved by the presence of an insoluble constituent. MnS in screw stock, carbides in spheroidized tool steel and lead in brass are some of the examples discussed under this head.
WLC (4d)

5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Nitrate Salt Baths for the Heat Treatment of Duralumin and Dangers They Present (Bano de sales a base de nitraotos para el tratamiento termico del duraluminio y pelogros que presentan) Ernesti Schenkel. *Metalurgia y Construccion Mecanica,* Vol. 2, June 1936, page 10. Studies are presented which have been made to determine the origin of the dangers of explosion which were formerly common with the use of nitrate salt baths for heat treatment.
FRM (5)

■ 5a. Annealing ■

Effect of Heat Treatment Between A_1 and A_3 on the Structure and Notch-Toughness of Low-Carbon Steels (Einfluss von Wärmebehandlungen zwischen A_1 und A_3 auf Gefüge und Kerbschlagzähigkeit kohlenstoffarmen Flussstahls) E. Dobinsky & H. Hanemann. *Archiv für das Eisenhüttenwesen,* Vol. 9, Jan. 1936, pages 359-366. By annealing between A_1 and A_3 the notch bar impact resistance of low-carbon steel can be raised over that in the normalized condition. This results from a change in the form of the pearlite (tending toward spheroidization). There was no change in grain size.
SE (5a)

The Bright Annealing of Silver in Gas Furnaces. P. Hopkinson. *Metal Industry,* London, Vol. 47, Dec. 20, 1935, page 614. A brief description of a process recently installed by a Sheffield (England) firm whereby a furnace of the continuous process type, heated by town gas, produces Ag thoroughly annealed, bright and free from "fire." The annealed material is discharged down a chute sealed in the water of the quenching tank. The air-gas ratio, which is kept constant, heats beds of broken refractory to incandescence which, reflected to the arch of the furnace, heats the Ag by radiation. The furnace handles 2000 oz. Ag/hr. on a gas consumption of 280 ft.^{3}/hr. The furnace was designed by Messrs. British Furnaces, Ltd. of Chesterfield.
HBG (5a)

■ 5b. Hardening, Quenching & Drawing ■

Methods of Hardening Cast Iron by Heat Treatment. J. S. Vanick. *Metal Progress,* Vol. 29, Jan. 1936, pages 40-43. Cast Fe can be hardened in same way as steel and its hardening power depends upon composition and structure of the matrix and distribution of graphite. Fine graphite and freedom from carbide masses or clusters, a tendency to harden evenly and deeply as cast and easy machinability are desired. Best compositions to obtain this result are low Si Fe for they are initially finer grained and less inclined to graphitize. High test Fe of low total C (2.80%) is also suitable, here Si should be low. In this latter type alloy additions enhance the value of heat treatment. Ni is especially effective by retarding graphitization and making for better carbide distribution. Cr and Mo increase depth of hardening. Microstructure exclusive of graphite should be that of 0.60%-0.85% C steel, martensitic, sorbitic or troostitic, but clear of carbide masses or free ferrite. Soft Fe of high Si will graphitize further in heat treatments. In all heat treatment of cast Fe heating time should be held as low as possible on this account. Quenching should be done in oil from temperatures of 1450°-1550° F. varying with alloy present. Application of hardened cast Fe to cylinder liners is described where composition of approx. 0.65% Cr, 2.0% Ni, Si 2.0%, total C 3.25% is used. A 500 Brinell cylinder has 3 times the life of a cylinder 240 hard. Possibilities of nitriding and cyaniding cast Fe are discussed. Pack hardening is probably of questionable value.
WLC (5b)

Heat Treated Rails for Special Trackwork. Edwin W. Goodaire. *Metal Progress,* Vol. 29, Mar. 1936, pages 59-64, 92. Describes development of heat treating equipment and technique used in making special trackwork of quenched and drawn rails. Data given show remarkable uniformity of hardness throughout the section of treated rails, Brinell 321 at center of head to 375 at surface.
WLC (5b)

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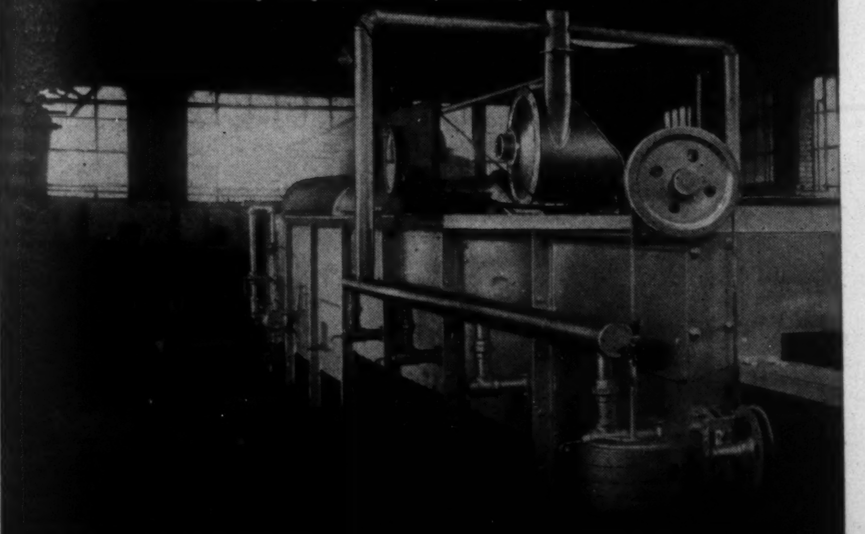

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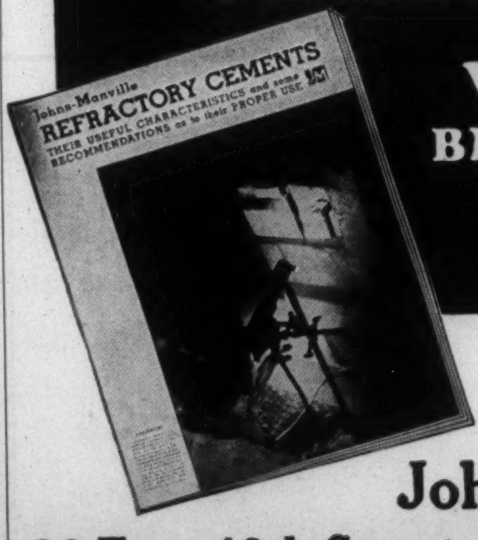
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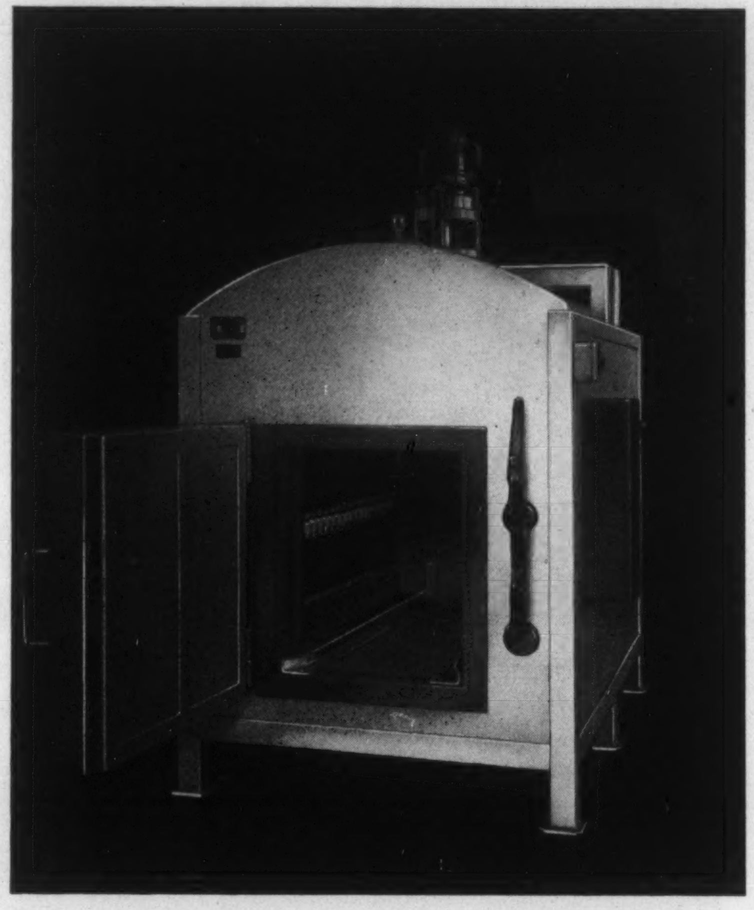

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5c. Aging

Age-Hardening Alloys and Their Application. R. H. HARRINGTON. *General Electric Review,* Vol. 39, Mar. 1936, pages 124-127. Types of age-hardening reactions discussed are simple precipitation hardening and simple lattice-strain hardening. Other causes of age-hardening effects are: (1) gas reactions within a metal lattice, (2) single solid solution phase in a quenched alloy may upon reheating entirely transform into a compound or into 2 solution phases of which either one or both may be harder than the original, and (3) recrystallization of cold worked metals or alloys to a finer grain size or efficient precipitation of a new phase along the lattice planes of maximum slip or deformation. Methods of research used are (1) cut-and-try method of varying the compositions and heat treatment of alloys already known to be age-hardening and employing additive elements in new compositions, (2) studying prospective alloys by means of the available knowledge recorded in the binary and ternary equilibrium diagrams of the involved elements. Applications of age-hardening alloys discussed include tool materials, duralumin alloys, Cu-Be alloys and Cu-Be-Co alloys especially useful for resistance welding electrodes. CBJ (5c)

Aging of Nickel-Beryllium Alloys (Über die Vergütung von Nickel-Beryllium Legierungen) WALTHER GERLACH. *Naturwissenschaften,* Vol. 24, Apr. 3, 1936, page 218. The magnetic properties of a Ni-2% Be alloy after heating and quenching from 1200° C. are: coercive force, less than 1 oersted, remanence about 10%, Curie point, 80-100° C., I_∞, 200-220 cgs. After annealing at 500° C. for 3 hours the magnetization increases 50%. The coercive force rises to about 100 oersted and the Curie point to 260°-270° C. This behavior is explained as due to aging. The Be separates leaving a Be-poor solid solution with a higher Curie point. The distorted solid solution presents a high magnetic hardness. The alloy is quite stable after the aging treatment as further heating at 300° C. does not effect any change. HAS (5c)

5e. Carburizing

Investigation of the Material of Sewing Machine Parts. Part III. H. KISHIMOTO. *Kinzoku no Kenkyu,* Vol. 12, Nov. 1935, pages 514-521. In Japanese. Specimens having various thicknesses were carburized under several conditions by means of the gaseous cementation process and the change of their length due to quenching was measured. It was found that the change of length for a comparatively thick specimen is in general smaller than that for a thin one. For the specimens having same thickness and carburized to the same depth, the relation between the elongation and ratio of thickness for carburized and uncarburized layers is as follows; the elongation becomes larger as the ratio of thickness of the layers gets smaller and vice versa. For the specimens of thin plate which could be carburized into the interior, the elongation increases in direct proportion to the C content. The change of length for quenched specimens after being aged was also measured. HK (5e)

Sodium Cyanide—Its Application in the Heat Treating and Finishing of Iron and Steel. F. E. D. GRIGGS. *Canadian Chemistry & Metallurgy,* Vol. 20, Apr. 1936, pages 112, 114. A brief discussion of NaCN carburizing. Advantages claimed for cyanide casehardening are: (1) saving in labor, (2) accurate control of depth of case, (3) freedom from distortion, (4) elimination of exfoliations, (5) a clean bright finish, and (6) required equipment is inexpensive. Other uses for cyanide are mentioned. WHB (5e)

Soft Spots on Hardened Steel. H. H. BLEAKNEY. *Iron Age,* Vol. 136, Dec. 12, 1935, pages 32-33, 94, 96. Based on Ehn and McQuaid's work on case carburizing, and also on work of other investigators, discusses formation of soft spots in hardened steel. Successful hardening of steel depends on method used, and inherent hardenability of steel. Author suggests that non-metalic inclusions or carbide affect the critical cooling rate, and therefore soft spots are formed when normal hardening speeds are used. In carburizing, dirty steel should be avoided. A case of eutectoid is desirable as a precaution against the formation of soft spots. Where case of excess C is used, final quenching temperature should be high enough to effect complete solution of excess carbide. VSP (5e)

Continuous Carburizing of Screws with City Gas. JOHN A. COMSTOCK. *Metal Progress,* Vol. 29, Apr. 1936, pages 44-46. Describes equipment and carburizing procedure conducted in rotating retort where the work slowly rolls through heating and carburizing zones and falls into quench through gas filled chute. Undried city gas diluted with products of combustion is carburizing medium. Speed of retort and temperature are controls used on depth of case and the ratio of raw gas to products of combustion controls C concentration in case. WLC (5e)

5f. Nitriding

Nitriding Steels and Nitriding. C. S. CUTCHER. *Heat Treating & Forging,* Vol. 22, Apr. 1936, pages 178-181. Paper read before the Steel Treatment Society, Australia. Outlines development of nitriding, gives composition of steels most generally used, and describes fabrication, nitriding process, advantages of nitride case, and applications. MS (5f)

Nitriding of Austenitic Steels. BRYMOR JONES. *Metal Progress,* Vol. 29, Feb. 1936, pages 39, 72. See *Metals & Alloys,* Vol. 6, Sept. 1935, page MA 358R/7. WLC (5f)

6. FURNACES, REFRACTORIES AND FUELS . . .

M. H. MAWHINNEY, SECTION EDITOR . . .

Insulation of Open-Hearth Furnaces. Survey of Results Obtained and of Materials Used. EDWIN F. CONE. *Metals & Alloys,* Vol. 7, Apr. 1936, pages 109-118. Questionnaire to 30 steel ingot and casting producers shows insulation used partially or completely. Complete insulation of furnaces is reported variously as producing no benefits to 30% increase in life. Reports returned are practically unanimous in production of fuel savings by insulation, estimates ranging from 5-30%. Various refractories used for insulation are described. Temperature limit control apparatus is described and briefly discussed. WLC (6)

Quality Brass and Copper Demand Quality Fuel. WENDELL L. CROSS. *Industrial Gas,* Vol. 14, May 1936, pages 9-10. A gas-fired pot furnace for tinning and bright-annealing in an atmosphere of steam is described. To avoid water stains on the Cu a cracked gas with about 1% CO and an air-gas ratio of 4:1 is used for cooling atmosphere. Ha (6)

New Electric Process for Cyanide and Activated Baths. E. F. DAVIS. *Metals & Alloys,* Vol. 7, June 1936, pages 143-146. Describes resistance heated salt bath furnace. Temperature distribution in pot 37" x 27" x 20" varies less than 5° F. Due to heat being applied internally (resistance effect in salt) the pot life is greatly increased. The heat insulation is effectively applied to reduce radiation losses. Cost figures are comparable to those for gas fired salt baths. WLC (6)

Special Methods of Gas Firing to Avoid Scale and Soft Skin. WINFIELD FOSTER. *Metal Progress,* Vol. 29, Jan. 1936, pages 51-52. Describes temperature and fuel-air proportioning controls for gas fired forge furnaces in which a relatively high pressure is maintained. Decreases of 66% in decarburization and 75% in scaling with more uniform product and greater comfort of workmen have been made possible. WLC (6)

Gas Firing Improves Columbia Tool Steels. WINFIELD FOSTER. *American Gas Journal,* Vol. 144, Feb. 1936, pages 31-32. Installation of gas-firing equipment is described. Finished product is improved in quality and scale loss has decreased. CBJ (6)

Heat Transmission in Steel-reheating Furnaces. J. E. EBERHARDT & H. C. HOTTEL. *Transactions American Society of Mechanical Engineers,* Vol. 58, Apr. 1936, pages 185-193. Some empirical formulas for the design of reheating furnaces are derived from tests with 5 continuous furnaces of different types; the tests are described. 5 references. Ha (6)

Notes on Copper Refinery Furnace Firing and Refractories. H. C. ROBSON. *Metal Industry,* London, Vol. 47, Oct. 18, 1935, pages 395-397, 402; discussion Nov. 22, 1935, pages 507-511. Paper presented at meeting of Institution of Mining & Metallurgy, Oct. 17, 1935, is based upon work conducted for the purpose of effecting fuel and refractory economies at the furnaces of the Indian Copper Corp., Ltd. The plant had 2 refining furnaces, each of which was large enough to handle full production. One furnace used pulverized coal and the other was grate-fired, using lump coal. The second furnace was changed to use pulverized coal as this method was found to reduce fuel cost 55%. The advantages of pulverized coal firing over grate firing are listed. The burners used were redesigned to increase efficiency and waste heat was utilized to heat feedwater. High-grade fire clay bricks—containing 70% Al_2O_3—and magnesite bricks were tried as substitutes for more expensive silica lining containing 90% ground quartzite and 10% fire clay, but without success. Eventually larger sized bricks of the original material proved to be an economy as the number of joints was reduced. A change from a fixed roof to a detachable roof proved to be another economy. The advantages of this type of roof are cited. HBG (6)

The Employment of Blast Furnace Gas Industrial Furnaces with the Aid of Steel Recuperators. A. SCHACK. *Demag News,* Vol. 10C, Mar. 1936, pages C1-C8. The advantages to be obtained by preheating gas and air when using blast furnace gas, and the practical utilization of the principles are explained. A continuous ingot heating furnace for an hourly output of 25 tons, heating the cold ingots to 1250°-1350° C. is described in detail, and the thermal balance made up. The thermal efficiency for the air recuperator is 78%, that of the gas recuperator 67%. Ha (6)

Physical Aspects of Refractory Insulation. JOHN D. SULLIVAN. *Brick & Clay Record,* Vol. 88, Feb. 1936, pages 74-76. To decrease heat flow use: (1) a thick wall of dense brick, (2) a light-weight or porous brick, (3) a combination of dense and light brick, (4) a combination of dense brick and some loose or non-shaped insulation. Light-weight brick may be used (1) as a light-weight structural material and (2) as an insulating material. Light weight brick are porous and are not suited for use as containers for metals, glasses or slags. They may be used as back-up materials for walls of furnaces or for operations not involving liquid states. CBJ (6)

The Temperature Difference Method of Open-hearth Furnace Reversal. A. SMITHSON. *Metallurgia,* Vol. 13, Apr. 1936, pages 188-190. Discusses systems and and describes semi-automatic system based on temperature differences of thermocouples located just outside cold end of checker work. JLG (6)

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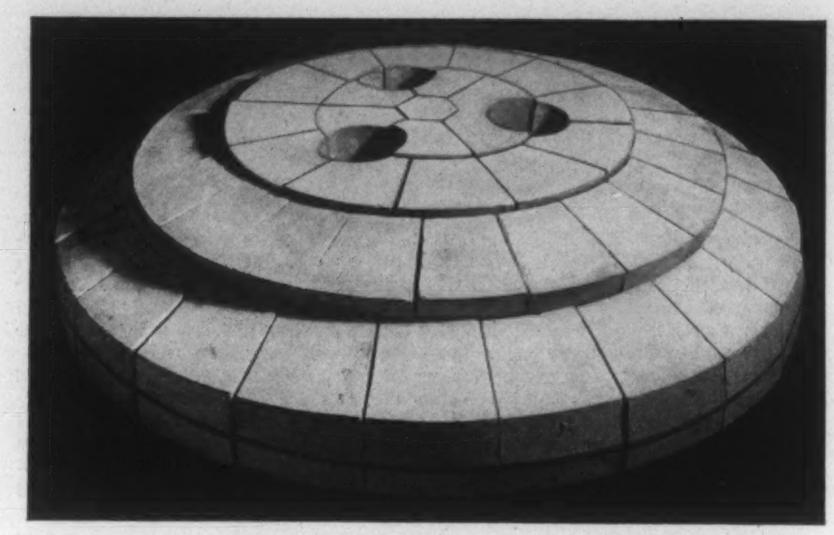

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Applications of Controlled Atmospheres to Heating. T. B. Bechtel. *Heat Treating & Forging,* Vol. 22, Jan. 1936, pages 39-42. **Practical Applications of Controlled Atmosphere Furnaces.** *Industrial Heating,* Vol. 3, Apr. 1936, pages 221-228. Conditions which make the use of controlled atmosphere in heat treating furnaces necessary are discussed and equipment and types of furnaces suitable for such control are described. Ha + MS (6)

Presents Detailed Data for Construction of Small Size Cupola. H. W. Kelly. *Foundry,* Vol. 64, Feb. 1936, pages 34, 84. Describes a small unit for melting alloyed mixtures of ferrous and non-ferrous metals for experimental purposes. VSP (6)

Increased Economy by Modern Heating Methods for the Hardening Shop (Gesteigerte Wirtschaftlichkeit durch moderne Feuerstätten der Härterei) Otto Lich. *Automobiltechnische Zeitschrift,* Vol. 39, Apr. 10, 1936, pages 183-186. Salt baths, heating furnaces, burners and general equipment for hardening processes, and for producing and controlling temperatures up to 1300° C. are reviewed and special features described. Ha (6)

Stevens Open Hearth Furnace. *Blast Furnace & Steel Plant,* Vol. 24, Feb. 1936, pages 157-159. Same as "Furnace Design and Operation," *Heat Treating & Forging,* Dec. 1935. See *Metals & Alloys,* Vol. 7, May 1936, page MA 234R/2. MS (6)

Waste-heat Boilers in Open-hearth Practice. *Iron & Steel Institute,* Special Report No. 10A, May 1936, 63 pages. Discussion, correspondence and committee's reply to Report No. 10. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 494R/8. JLG (6)

Production and Uses of Insulating Firebrick—Advantages in Furnace Construction. *Metal Industry,* London, Vol. 47, Dec. 20, 1935, pages 608-610, 619. This type of firebrick is a new development in refractories. While well established in some industries its use is somewhat limited. Reference is made to the paper recently contributed to the Refractories Materials Section of the Ceramic Society by Dr. F. H. Norton, Assoc. Prof. of Ceramics at Mass. Inst. of Tech. Only within the last 5 years has the advantage of the use of insulation inside the furnace been recognized. This led to the development of insulating firebrick. The 4 general methods of producing the necessary porous structure are (1) formation of bubbles in the soft mix, (2) the addition of a porous material, e.g. infusorial earth, (3) the burning out of organic material in the mix, and (4) the sublimation of solid particles in the mix. The physical properties of some commercial bricks are discussed. These include weight, porosity, thermal conductivity, after shrinkage, hot and cold strengths and spalling tests. The advantages of this type of firebrick are low heat storage capacity, low thermal conductivity, a more uniformly heated product, greater efficiency of combustion and the sound-absorbing property of the brick. The chief limitations are lack of resistance to slag, low resistance to abrasion, low resistance to mechanical vibration and low resistance to spalling. Methods of use in furnace design are discussed. HBG (6)

Use Petroleum Coke to Raise Temperature of Iron in the Cupola. James A. Murphy. *Foundry,* Vol. 63, Dec. 1935, pages 35, 78. Having difficulty in obtaining heat above 2400° F., the author used petroleum coke with a fixed C of 86.50%. Results showed that metal temperature at the spout was never below 2700° F. and a few readings showed 2750° F. VSP (6)

Experiences on Automatic Temperature Controllers of Gas-Fired Industrial Furnaces (Erfahrungen mit selbstätigen Temperaturreglern an gasbeheizten Industrieöfen) H. O. Meyer. *Die Wärme,* Vol. 58, Dec. 14, 1935, pages 819-824. The 2 principal methods of controlling gas-fired furnaces are given, the controllers are described and special attention is devoted to the control of furnaces having a larger heat capacity. EF (6)

Development of the Continuous Vitreous Enamelling Furnace. W. Marshall. *Sheet Metal Industries,* Vol. 9, Dec. 1935, pages 774-776. A paper before the Institute of Vitreous Enamelers. A general discussion pointing out the advantages of the U-type furnace. AWM (6)

New Combination Color Pyrometer with Comparison Lamp (Ein neues kombiniertes Farbpyrometer mit Vergleichslampe) G. Naeser. *Archiv für das Eisenhüttenwesen,* Vol. 9, Apr. 1936, pages 483-485. Previously used optical pyrometers give uncertain results because of the uncertainty of the black body conditions of the temperature source. A combination color-brightness pyrometer is described which enables obtaining the true temperature of a continuous spectrum radiator within ± 10° C. Whether or not black body conditions exist can be ascertained by a single measurement. SE (6)

Infiltrated Air in Furnace Operation (Falschluft im Ofenbetrieb) H. Schwiedessen. *Archiv für das Eisenhüttenwesen,* Vol. 9, Jan. 1936, pages 319-326. Infiltrated air results from low pressure in the furnace chamber and loose places in the brick work. Infiltrated air lowers the temperature differential between the incoming and outgoing gases and raises the amount of gases going up the stack, causing lower output and higher fuel consumption. Proper use of chimney dampers, tight brick work, avoidance of superfluous doors and openings, and proper design of furnace chamber can lower the amount of infiltrated gases. The furnace can also be run with excess gas pressure, particularly after infiltration of air occurs. SE (6)

Box-type Furnace with Air Circulation for Heat Treatment of Coiled Strips of Light Metal (Der Schachtglühofen mit künstlicher Luftumwälzung zur Warmbehandlung von Bandringen aus Leichtmetall) O. Gengenbach. *Elektrowärme,* Vol. 5, Apr. 1936, pages 113-122. Examples of different types of furnaces, methods of control and heating in definite schedules are described and illustrated. Ha (6)

Graphite Resistor Radiation Furnaces. Henri George. *Metal Industry,* London, Vol. 47, Nov. 8, 1935, pages 469-470. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 190L/4. HBG (6)

7. JOINING

7a. Soldering & Brazing

C. H. CHATFIELD, SECTION EDITOR

Soldering and Jointing. Aluminum and Copper to Aluminum. F. P. Morrough. *Electrician*, Vol. 116, Apr. 24, 1936, page 532. Use of Al in the electrical industry has made necessary methods for joining Al to Cu and to Al. Molten solder breaks down the oxide film of Cu and brass but is ineffective with the oxide film on Al. Surfaces to be soldered should be "tinned". 60% Sn 40% Zn solder gives satisfactory results, best solder for Al joints is 60% Zn and 40% Cd solder. CBJ (7a)

Recent Advances in Soldering and Brazing. C. L. G. Ashby. *Metal Industry*, London, Vol. 47, Aug. 16, 1935, pages 151-153. Points out that an essential property of soldering is that it alloy with the metals being joined. This is dependent upon the fluidity of the solder, its affinity for the alloys in question, and the efficiency of the flux used. Soldering and brazing are compared with welding and it is shown that the temperature at which the joining is done is, perhaps, the major difference. There is not, as yet, a generally suitable solder alloy for use at a temperature within the range of 350°-600° C. This is due to the exacting demands of modern requirements which are listed. Some Ag solders have been developed which meet some of the requirements. The old arbitrary mixtures of Ag and brass have been superseded by a series of alloys based on the ternary system of Ag-Cu-Zn, each of which is fitted to meet certain conditions. These alloys have been further modified by additions of other elements of which Mn, P, and Cd appear to yield the greatest benefits. At the lower end of the gap between "hard" and "soft" soldering greater difficulties are experienced due to the fact that these alloys form eutectiferous alloys with each other. However, alloys containing 2 or more of the metals Cd, Zn, Sn, Pb and Ag can be used successfully. Another major difficulty is the flux to be used. The 3-fold purpose of the flux is mentioned and examples given for both the low-melting as well as the higher-melting alloys. HBG (7a)

Brazing of Gray Cast Iron. G. van Alstine. *Industry & Welding*, Vol. 7, Dec. 1935, pages 15-17. The difficulties of bronze welding of gray cast Fe are discussed. Some practical hints are given. Preheating should not be above about 1300° F. The pieces should be cleaned thoroughly from all grease, scale and rust. Use of bronze or Mn-bronze rods with brazing flux is recommended, and cast Fe flux for difficult "tinning". Ha (7a)

Conservation of Tin. A. J. T. Eyles. *Sheet Metal Industries*, Vol. 9, Sept. 1935, page 563. Lower Sn content is not detrimental in many joining solders. Substitution of Cd for part of the tin is recommended. One with Pb 80%, Cd 10%, Sn 10% has about the tensile strength of 40-60 Sn-Pb solder and about twice the ductility. AWM (7a)

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

Welded Structures from Scrap Material (Schweisskonstruktionen aus Schrottmaterial) E. C. Karch. *Autogene Metallbearbeitung*, Vol. 29, May 1, 1936, pages 137-138. Economies can be obtained by using material which usually is sold as scrap in welded constructions, which are often cheaper than castings and suit their purpose better. Ha (7b)

Further Studies on Internal Stresses in Ordinary Welded Seams (Weitere Untersuchungen über Eigenspannungen in einfachen Schweissnähten) F. Bollenrath. *Archiv für das Eisenhüttenwesen*, Vol. 9, Oct. 1935, pages 203-207. The contraction stresses in V-welds with bare and covered electrodes were determined by measuring the change in diameter of a drilled hole in the weld and the change in length of strips cut from the weld. Intermittent welding gave lower internal stresses than continuous welding. By proper subdivision of the seam (length of seam about 10 × thickness of plate) the stresses in the direction of the seam can be reduced to ⅓ the values in continuous welding; the transverse stresses remain the same. In thicker plates × seams gave lower stresses than V seams. SE (7b)

Status of Welding Technique in the Ruhr Mining Industry (Stand der Schweisstechnik im Ruhrbergbau) K. Baatz. *Glückauf*, Vol. 72, Jan. 18, 1936, pages 62-67. Observations and experiences in the use of welding in the repair of fractured machine parts, worn rails, boilers, etc. are reviewed. The necessity for having skilled welders is emphasized. Ha (7b)

The Welding of Pressure Vessels. S. F. Dorey. *Journal Institution of Petroleum Technologists*. Vol. 22, Apr. 1936, pages 211-223. The primary consideration in the welding of these vessels is the proper reduction of parent plate material. Main factors to observe are (1) differential freezing effect during welding; (2) electrolytic corrosion tendency between dissimilar metals; (3) physical properties of joint. The Committee on Welding in England has set the following requirements for plate material: C 0.1-0.2%, S 0.04% max., P 0.05% max., Mn 0.4-0.6%, Si 0.2% max. The steel should be acid or basic open hearth. Electrode requirements are: C 0.06-0.12%, Si 0.05%, Mn 0.4-0.5%, S and P 0.015% max.; the rods should be coated with a compound which produces a reducing gas shield to the weld, also a neutral slag; easy to apply; non-splattering; uniform deposit rate. The welding technique is discussed, manual vs. machine welding advantages, residual stress and strain relieving, and testing and inspection procedure. AAA (7b)

Relations Between Elasticity and Endurance Limit in Welds (Elastizitätsverhältnisse in Schweissverbindungen und deren Zugschwingungsfestigkeit) E. Diepschlag, A. Matting & G. Oldenburg. *Archiv für das Eisenhüttenwesen*, Vol. 9, Jan. 1936, pages 341-345. Tension-fatigue tests of arc and gas welds of structural steel indicated that the endurance limit was lower the greater the difference in elastic deformability between the base and weld metal. A high endurance limit of the weld was obtained when (1) the elastic deformability of the weld and base metal were nearly alike so that stress concentrations at changes in section were not high and (2) when the stresses were well distributed by inclining the seam in the direction of the tensional forces; a more gradual transition between the base and weld metal can also be obtained by deeper melting of the base metal. SE (7b)

Investigations into the Corrosion of Welded Steels in Humid, Warm Air (Untersuchungen über die Korrosion von geschweissten Stählen in feuchter warmer Luft) E. Diepschlag. *Autogene Metallbearbeitung*, Vol. 29, Apr. 15, 1936, pages 113-117. Comparative tests were made with Armco Fe and several (German) structural steels to find differences in the corrosion in warm, humid air when welded differently and later exposed to a current of steam at different temperatures. The results are shown in curves. It could be stated that the corrosion of welded samples under such conditions cannot be directly connected to the properties of the material, but that the method of welding and the nature of the welding rod can become of much greater importance and overshadow them. Ha (7b)

Modern Methods of Welding. C. H. Davy. *Chemistry & Industry*, Vol. 54, Dec. 6, 1935, pages 1054-1057; *Chemical Trade Journal & Chemical Engineer*, Vol. 97, Oct. 11, 1935, pages 305-306; Oct. 18, 1935, page 328. See *Metals & Alloys*, Vol. 7, Apr. 1936, page MA 190R/7. AAA + MS (7b)

Oxy-Acetylene Welding of Sheet Metals. A. J. T. Eyles. *Sheet Metal Industries*, Vol. 10, Feb. 1936, pages 172-174. General discussion of the welding technique for Al, Cu, brass, Mg alloys, and Zn and galvanized sheets. AWM (7b)

Developments in Welding Copper Alloys. I. T. Hook. *Iron Age*, Vol. 137, Feb. 20, 1936, pages 40-41. Discusses the welding of Cu alloy containers of all types to improve quality and economy in manufacture. The metal is largely Cu 96-98% with 1.5-4% Si, and the addition of one or more elements. Bronze welding has been much used the past year. Steam engine pistons or rings are coated with Mn bronze by oxy-acetylene. Be-Cu is finding many new applications. Use of Ambrac (20% Ni) and Supernickel (30% Ni) has increased for marine condensers. They are easily fusion welded. VSP (7b)

Advances Made in Welding of Aluminum. G. O. Hoglund. *Iron Age*, Vol. 137, Mar. 19, 1936, pages 46-47. Economies in joining Al by electric resistance spot, seam or butt welding have been utilized during 1935 for widely varying industrial applications. Equipment is now available in which the various steps are closely controlled. Commercial flash butt welding of Al for use on bicycle rims and automobile window trim was developed the past year. Advances in metallic arc welding of Al have been chiefly in expanding the field of application. Oxy-hydrogen torch is still the most widely used tool for Al welding. VSP (7b)

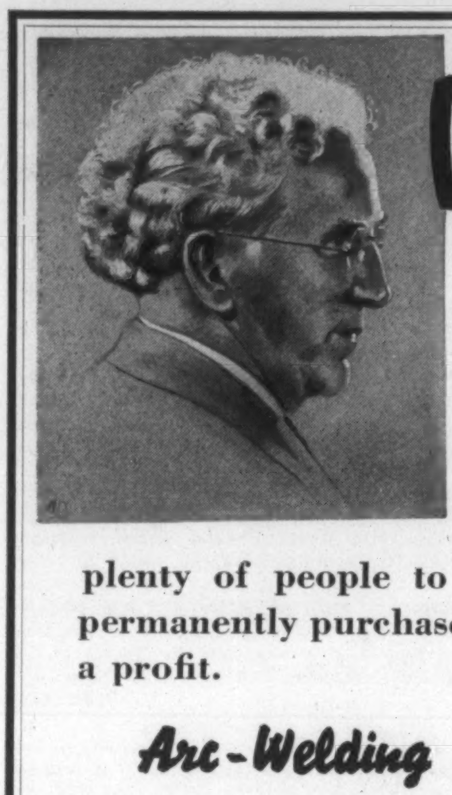
Tube Making in Australia. A. N. Hamilton. *Proceedings Australasian Institute of Mining & Metallurgy* No. 99, Sept. 30, 1935, pages 375-442, 463-464. Butt welding by the Bell process and by the Fretz-Moon continuous process is described in detail. AHE (7b)

Effect of Cold Work on the Welding Properties of Bare Electrodes (Der Einfluss der Kaltverformung auf die Schweisseigenschaften nackter Stahlelektroden) A. Kessner & H. Specht. *Archiv für das Eisenhüttenwesen*, Vol. 9, Nov. 1935, pages 231-239. How the welding properties of bare electrodes in the welding of structural steel St 37 and St 52 are affected by cold working and subsequent annealing was determined. Spattering, density of the weld, and the appearance of the bead, were unfavorably influenced by cold work. The dripping test frequently used for testing electrodes gave no correlation with the quality of the welds. The strength, elongation, and angle of bend of the welds, decreased with cold drawn electrodes and the welds gave a poor looking structure with inclusions and blow holes. The impact resistance increased, however. These effects of cold working were ascribed to the decrease in electrical and thermal conductivity of the electrodes. The rods get hotter during welding and melt faster, this being detrimental. SE (7b)

Welding and Cutting Technique at the Great Technical Fair in Leipzig in 1936 (Schweiss- und Schneidtechnik auf der Grossen Technischen Messe 1936 in Leipzig) H. Kemper. *Autogene Metallbearbeitung*, Vol. 29, Apr. 1, 1936, pages 97-108. A great number of welding, cutting, universal and special machines for gas and electric welding processes are described and illustrated, including burners, torches and equipment for surface hardening. Ha (7b)

Repairing the Oil Casings of Submarine Diesel Engines by Electric Welding. Maurice Lebrun. *Gas & Oil Power*, Vol. 31, Feb. 1936, page 52. Application of electric welding to repairing crankcases damaged by explosion is described. Time, labor, power, dimensions and strength of welds, and general difficulties and precautions are detailed. FPP (7b)

Welding in Bridge Work. A. R. Wilson. *Railway Engineering & Maintenance*, Vol. 32, Jan. 1936, pages 20-21. From paper presented before American Railway Bridge and Building Association Convention, October, 1935. Welding of bridge structures is historically and geographically reviewed. Welding bridge structures introduces unique problems, as compared to welding buildings, as more varied forms and sizes of structure, and hence more detailed design are involved. Advantages of welding over older methods of bridge construction and repair are cited and the advent of all-welded bridges for both highway and railroad is predicted. FPP (7b)



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Production of Diesel Locomotives. *Heat Treating & Forging,* Vol. 22, Apr. 1936, pages 174-177. **Modern Industrial Structures House Diesel-Electric Locomotive Plant.** *Steel,* Vol. 98, Apr. 13, 1936, pages 32-35. Description of plant of Electro-Motive Corporation at La Grange, Ill. Structural steel of buildings was erected by electric welding. There are several electric traveling cranes, the 200-ton crane being the largest unit of this kind ever welded. MS (7b)

Gas-fusion Welding in Steel Structures (Gasschmelzschweissung im Stahlbau) E. Bothmer. *Autogene Metallbearbeitung,* Vol. 29, Apr. 15, 1936, pages 119-120. The welding procedures used in the erection of a large hall of 30 x 48 m. with spans of 12 m. are described. Ha (7b)

Welded Plate Girder Bridges for Railways. O. Bondy. *Railway Gazette,* Vol. 64, Apr. 3, 1936, pages 652-654. Large welded bridges, increasingly common on railroads, impose new problems of design, workshop practice and particularly welding practice. Thermal distortion may be predicted and allowed for, and internal stresses reduced by use of rotary jigs to enable welding of plate girders in a horizontal position. Best electrode practice is to use small electrodes and to deposit thick welds in a number of layers. Coated electrodes are used for butt welds and bare electrodes for other joints. Latest developments and methods of evaluating quality, with special reference to German practice are discussed. FPP (7b)

Status of Electric Spot-welding for Aluminum and Its Alloys (Stand der elektrischen Punktschweissung für Aluminium und seine Legierungen) F. Bollenrath & W. Bungardt. *Aluminium,* Vol. 18, Apr. 1936, pages 125-133. The use of spot-welding of light metals is discussed from the point of view of their physical, chemical and structural properties. These require particular attention to current, form of electrodes, and pressure applied if a pure recrystallization weld is to be obtained. As comprehensive tests (which are described) have shown this is the desirable weld for strength and corrosion resistance. Ha (7b)

Cylinder Sleeve Welding. *Aluminium & the Non-Ferrous Review,* Vol. 1, Oct. 1935, pages 36-37. Procedure in repairing cracked cylinder block and sleeving the bores is described. Pure welding, bronze welding, and hard soldering were utilized. JCC (7b)

Proposed Uniform Test Procedure for the Qualification of Operators of Welding Equipment. *Welding Journal,* N. Y., Vol. 14, Dec. 1935, pages 25-26. Descriptive. WB (7b)

Welding Operations Aid in the Production of Machine Tools. F. B. Jacobs. *Welding Engineer,* Vol. 20, Dec. 1935, pages 30-33. Examples illustrate various applications. Ha (7b)

Welding Nickel-clad Steels. F. P. Huston & T. T. Watson. *Industry & Welding,* Vol. 7, Dec. 1935, pages 50-55. Methods used for welding with the metallic arc, C arc, acetylene and atomic H and preparation of work are described in detail. Ha (7b)

Electric Arc Welding and Its Applications VI. M. Maurice Lebrun. *Welding Journal,* British, Vol. 32, Nov. 1935, pages 326-328, 331. Continuation of discussion on electrodes and their characteristics as applied to welding of gray cast iron with mild steel, pure Ni, Ni-Cu (high Ni) welding rods; also with cast Fe rods after preheating. Rods for malleable Fe, Cu, bronze are briefly reviewed. WB (7b)

Welding in the Construction of the "Silver Jubilee" Train. *Welder,* Vol. 8, Dec. 1935, pages 773-777. Full description of design and welding is given. Ha (7b)

Gas Welding Applied to the Construction of Monuments (Die Autogenschweissung im Denkmalbau) B. Bibus. *Der Autogen-Schweisser,* Vol. 8, Sept. 1935, pages 97-98. Some characteristic examples are shown in which welding was advantageously applied to the assembling of complicated parts of monuments. WH (7b)

Assembling the New Steel Radio Tube by Electrical Resistance Welding. M. L. Eckman. *Welding Journal,* N. Y., Vol. 15, Feb. 1936, pages 10-12. Advantages for the metal tube are reviewed respecting electrical factors, production and ease of compact assembly in radio. The various steps of tube assembly are discussed and illustrated. WB (7b)

Resistance Welding. L. H. Frost. *Welding Engineer,* Vol. 21, Feb. 1936, pages 38-40; Mar. 1936, pages 32-33. Principles and practices involved, preparation of material and selection of electrodes are discussed in detail. Ha (7b)

Electrodes for Electric Resistance Welding (Les Electrodes pour Soudure Electrique par Résistance) J. Fassbinder. *La Technique Moderne,* Vol. 28, Feb. 15, 1936, pages 121-126. Cu is still much used for manufacturing electrodes. Pseudo-alloys of W and Cu ("Elkonite" and "Elmet") are also adopted for making tips of electrodes. Cu with additions up to 1% of elements entering into solution such as Co, Cd, Be is also used for making electrode tips. Some new products known as "Cuivrélect" and "Inuso" also give good results. Little is actually known about them. FR (7b)

Welding Hard Facings on Drilling Tools. J. Cuthill. *Journal Institution of Petroleum Technologists,* Vol. 22, Apr. 1936, pages 205-210; *Mining Journal,* Vol. 192, Feb. 15, 1936, page 122; Feb. 22, 1936, pages 155-156. The various hard facing materials fall in 4 classes: (1) Hard metal alloys, principally combinations of C, Cr, W, Mo, Ta, Co, and sometimes Fe (Stellite, Stoodite), (2) diamond substitutes, principally WC, to be embedded in cutting edges (Borium, Haystellite), (3) granular C substitutes, principally WC held in steel tubes (Tube Borium, Borod), and (4) WC powder for welding to steel with an electric arc (Blackor, Britor). Methods for their application to tools are described. AAA + AHE (7b)

A New Welding Process. *Gas & Oil Power,* Vol. 30, Sept. 1935, pages 211-212. Describes the Barimar-Sopromo oxy-acetylene coal gas welding process. Acetylene and coal gas are premixed and when burned with O provide a lower temperature welding flame than oxy-acetylene. Welds are purer because of decreased oxidation and, with cast Fe, avoidance of carburization; bubbling, heat-spreading and low-strength welds are eliminated. FPP (7b)

The Use of Welding in Transportation and Storage of Oil. A. C. Hartley & A. C. Vivian. *Journal Institution of Petroleum Technologists,* Vol. 22, Apr. 1936, pages 224-232. Welding effects great economies in pipe line construction, an approximate saving of 20% over screw-thread pipe. Welded lines enable higher working pressures with larger volume thru-put. The article gives complete description and data on pipe line construction in Iraq. AAA (7b)

Fusion Welding for Boiler Work. *Steam Engineer,* Vol. 5, Apr. 1936, pages 284-286. Arc welding is described. The properties of the weld metal, before and after deposition, are presented tabularly and photomicrographs of various parts of a weld are given. AHE (7b)

Welding of Rail Joints (Beitrag zur Schienenstoss-Schweissung) W. Miller. *Autogene Metallbearbeitung,* Vol. 29, Apr. 15, 1936, pages 120-122. Describes welding method used for joining rails of different heights of web which was made necessary in a railway tunnel. Ha (7b)

Long Welded Rails. *Railway Gazette,* Vol. 64, Mar. 6, 1936, pages 447-451. Reprint of paper presented by H. S. Clarke before Chicago Maintenance of Way Club. Primarily to increase travel safety the Del. and Hudson R. R. has installed continuous rails up to 6,970 ft. in length. Other disadvantages than accident hazard of jointed rails are discussed. Thermit pressure welding is used most although electric flash welding has been applied to a slight extent. Danger of long-track hot weather buckling may be obviated by welding the track in summer, as only inherent stress thereafter will be the increased tension in cold months, far below the elastic limit of rail steel. Two types of .35-.40 Mo and .04 max. P steels, differing slightly in C, Mn and Si contents are being welded. Details of construction are given. FPP (7b)

Eliminating the Rail Joint. *Railway Gazette,* Vol. 64, Mar. 6, 1936, pages 433-434. Description of advantages of and advances in use of long welded jointless rails on roads in Great Britain, France, and Germany is given. German technique stresses safety even with radical experiments. FPP (7b)

Welding in Locomotive Construction. *Railway Gazette,* Vol. 64, Feb. 28, 1936, pages 400-403. Illustrated description of electric welding of locomotive components, an operation that is gradually replacing the use of castings, riveted angle or flanged plates, is given. The use of positioning jigs and tack welding provides a higher degree of accuracy than is obtainable in steel castings of similar type and size. Welding of "smokebox saddle," "ashpan," cylinders, wheel spoke flaws, boiler joints, spring casings, etc. is described. Requirements to be satisfied before change to electric welding include: equivalence or superiority of quality of new unit compared to old cast or riveted work, minimum of machining, minimum weight consistent with requirements, economic advantage. Advantages claimed are elimination of costly patterns, continuous production of the welded unit and possibility of immediate local production eliminating excessive stock inventories. FPP (7b)

Welded Pipe Structure (Kleines Beispiel für die Praxis) H. Kreyenberg. *Autogene Metallbearbeitung,* Vol. 29, Apr. 15, 1936, pages 122-123. A structure for lifting 5000 kg. entirely welded together from pipes is described. Ha (7b)

The Training of Electric Welders. A. G. Poole & R. T. Rolfe. *Journal, Institution of Petroleum Technologists,* Vol. 22, Apr. 1936, pages 233-246. A semi-technical lecture course for apprentice welders, profusely illustrated with drawings of various types of welds, explanation of the welding technique, numerous photographs, micrographs, X-ray and other illustrations showing good vs. bad welds. Individual welder evaluation charts are given. AAA (7b)

Oxy-acetylene Welding. L. C. Percival. *Aluminium & Non-ferrous Review,* Vol. 1, Jan. 1936, pages 161-167; Feb. 1936, pages 202-207. Read before Swansea Local Section of Institute of Metals. A general account of the procedure in oxy-acetylene welding Al and its alloys, Mg alloys, brasses, and Cu; in bronze-welding cast Fe, Cu and steel; in hard-facing; in joining with Cu-P alloys, and in welding Zn-base die castings. JCC (7b)

New Importance of Welding in Construction. W. Spraragen. *Civil Engineering,* Vol. 6, Mar. 1936, pages 151-155. In designing welded structures, consideration must be given to such factors as residual stresses, stress concentrations, and the reduction of the amount of welding to a minimum. Examples of recent applications to pipe and gas-holder construction, buildings, and bridges are quoted. JCC (7b)

Improved Welded Structures by Combining Acetylene Welding with Acetylene Cutting Technique (Verbesserte Schweisskonstruktionen durch Verbindung der Azetylenschweiss- mit der Azetylenscneidtechnik) J. Sehring. *Autogene Metallbearbeitung,* Vol. 29, Mar. 1, 1936, pages 68-69. Some unusual fabricated structures, otherwise usually cast, are described. Ha (7b)

Resistance of Welded Machine Structures to Vibration. R. Tweetside. *Modern Machine Shop,* Vol. 8, Apr. 1936, pages 44-50. Besides the recognized advantages of welded structures, especially as machinery bases due to freedom from limitations of pattern, lighter weight and flexibility of construction, the vibrations caused by electric or reciprocating machinery can be much better overcome by suitably ribbing or stiffening the structure without the increase of weight as in cast structures. Examples are described. Ha (7b)

Modern Developments in Welding. C. G. Bainbridge. *Welding Journal,* British, Vol. 33, Mar. 1936, pages 81-84. General discussion of maintenance and repair. Practical problems in repair of castings and application of hard-facing are reviewed. WB (7b)

Arc Welding in Argon Gas. G. E. Doan & Wm. C. Schulte. *Welding Journal,* N. Y., Vol. 15, Jan. 1936, pages 23-27. See *Metals & Alloys,* Vol. 7, May 1936, page MA 241L/2. WB (7b)

Aircraft Requires Welding in Many Parts. Carl de Ganahl. *Metal Progress,* Vol. 29, Feb. 1936, pages 61-63. Describes fusion welding of 1% Cr, 0.25% Mo, 0.30% C steel and 18-8 stainless in aircraft. Spot welding is very satisfactory for 18-8 but not for Cr-Mo steel on account of air hardening effects. Addition of Ti and Cb to 18-8 prevents welding decay. WLC (7b)

Welded Pressure Vessels and Containers. C. H. Davy. *Welding Journal,* British, Vol. 33, Feb. 1936, pages 42-44. Discussion of papers presented at Symposium on Welding on this subject. WB (7b)

Resistance Welding in Refrigerator Manufacture. M. L. Eckman. *Machinery,* N. Y., Vol. 42, May 1936, pages 590-593. Newly developed methods and equipment used for flash- and seam-welding of thin sheets are described. Ha (7b)

Welding Sheet Aluminium. A. J. T. Eyles. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, pages 340-342. The technique of welding sheet Al and Al alloy with the oxy-acetylene blowpipe is briefly described. JCC (7b)

High Pressure Piping. J. A. Freiday. Presented at 36th Annual Convention, *International Acetylene Association,* Vol. 12-15, 1935, 6 pages (available in mimeographed form from the offices of the Association, 30 East 42nd Street, New York, N. Y.); *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 2-5. Erection and oxyacetylene welding of 8400′ long, 12¾″ O.D., ⅜″ wall, lap welded steel pipe line for high-pressure, high temperature out-of-door steam service between plants of U. S. Industrial Alcohol Co. and U. S. Industrial Chemical Co., Baltimore, Md. See also *Metals & Alloys,* Vol. 7, May 1936, page MA 242L/7. EVD + WB (7b)

Atomic Hydrogen Welding. A. L. Guest. *Metal Treatment,* Vol. 2, Spring 1936, pages 17-23. Atomic H arc welding equipment is described, and its operation and applications discussed. An exceedingly hot concentrated flame is obtained by blowing H through an arc between W electrodes. The most important application is for welding mild sheet steel, in which clean, sound, ductile welds can be made at high speeds. Curves showing welding speed and consumptions of current, W, and H when welding sheets of various thickness are given. Automatic machines are used for welding radiator elements. Atomic H welding is also used for constructing vacuum equipment, in which slag inclusions must be eliminated, and for joining special metals such as stainless steels, Nichromes, Ni, Monel metal, some brasses, Al and its alloys. JCC (7b)

Autogenous Cutting in Repairs (Autogenes Schneiden im Instandsetzungsbetrieb) H. H. Grix. *Autogene Metallbearbeitung,* Vol. 29, May 15, 1936, pages 154-155. Examples of unusual repairs and procedure of repairing by oxy-acetylene process with consumption of O and C_2H_2 are described. Ha (7b)

New Method for Welding Together Ferrous Metals by Application of Heat and Pressure. Leonard C. Grimshaw. *Engineering,* Vol. 141, Apr. 3, 1936, pages 383-386. **Bonding Ferrous Metals by Heat and Pressure.** *Steel,* Vol. 98, Feb. 24, 1936, pages 49, 51-54. See *Metals & Alloys,* Vol. 7, May 1936, page MA 238R/9. MS + VSP (7b)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

8d. Electroplating

American Standards for Nickel Plating of Steel (Amerikanische Normung der Vernickelung von Stahl) *Nickel Berichte,* Vol. 6, Apr. 1936, pages 57-59. Fully discusses the tentative standards of Ni plating of steel of the A.S.T.M. and the American Electroplaters' Society with which the Master Electroplaters' Institute has concurred. The specifications also include life testing of platings under atmospheric service. EF (8d)

Development of Nickel Plating at High Current Densities in France (Entwicklung der Vernickelung bei grossen Stromdichten in Frankreich) *Metallwaren Industrie & Galvano Technik,* Vol. 33, No. 20, 1935, pages 435-437. Sufficient corrosion protection is afforded if the thickness of the coating is increased to 10 μ and 25 μ for Cu and Fe respectively. An accelerated Ni process (6 and 12 min. respectively) has been developed by applying current densities of 7-10 amps./dm.^{2} The hot plating solutions are stirred and in addition to Ni-sulphate, contain Ni chloride to facilitate the solution of the anodes, boric acid to prevent rapid changes of the acid content of the electrolyte, and Ni nitrate to minimize the adhesion of H-bubbles. Eleven different operations are required for this process which, however, works automatically. The porosity of the coating is tested by K-ferro-cyanide and the bond is checked by simple bending tests. EF (8d)

Nickel and Chromium Plating. Progress and Present Situation (Nickelage et chromage. Progrès et situation actuelle) M. Ballay. *Revue de Métallurgie,* Vol. 32, Oct. 1935, pages 494-500. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 195L/6. JDG (8d)

Further Principles of Electrochemistry Applied to Electrodeposition. VIII. Buffering the Plating Solutions. Samuel Field. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Oct. 11, 1935, pages 378-379. Author differentiates between strong and weak electrolytes as those that dissociate freely or only to a small degree in moderate dilution. Conductance is dependent upon the number of ions present in acids and on their rates of migration, e.g. Na acetate, when mixed with HCl, tends to resist H-ion concentration, i.e. it acts as a buffer. Some advantages, attributed to the presence of buffering agents in electrodeposition, are cited and certain reactions at the cathode and anode, in their absence are indicated. HBG (8d)

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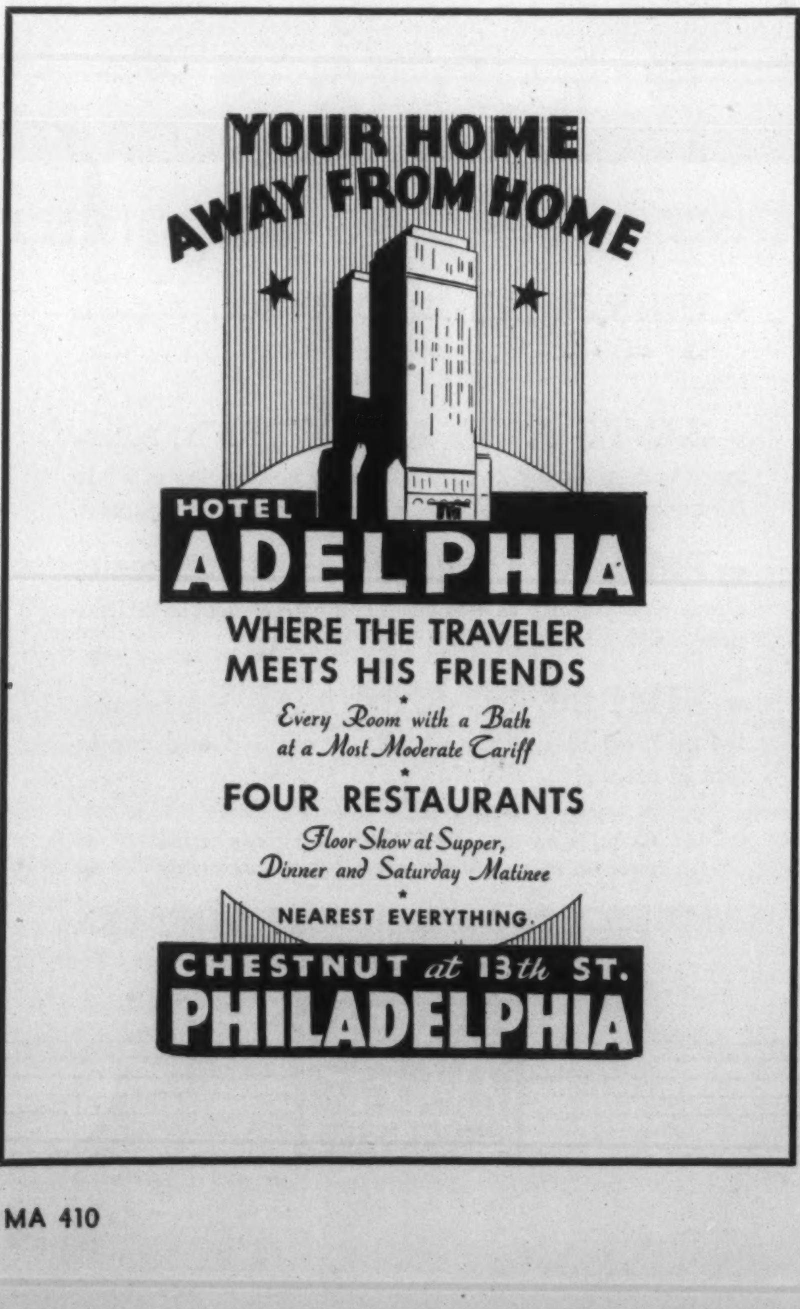
The Production of Non-Adhesive Deposits. E. A. Ollard. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Nov. 22, 1935, pages 519-521. Usually in electrodeposition, as in electroplating, a high degree of adhesion is necessary. However, in electroforming and electrotyping, success depends upon the ready separation of the deposited metal from the base. The author tabulates and examines the processes of the latter type now existing. These are grouped as (1) the use of a metal base to which the deposit does not adhere, (2) protection of the metal base by wax or some other mechanically applied layer, (3) the formation of chemical films on base metal by treatment with reagents, (4) the formation of thin layers of other metals by chemical or electrochemical means, (5) combination of (3) and (4), (6) adsorbed colloid layers. The advantages and disadvantages of each group are indicated and specific applications are described. Group (3), which is deemed most important, is discussed in greatest detail. Methods of forming the film and the solutions used are described. HBG (8d)

Gilding and Silvering Large Metallic Surfaces. Yu. V. Baimakov. *Metallurg,* Feb. 1936, pages 3-8. In Russian. Au plating and Ag plating of articles measuring 3 x 2 meters did not present any unusual difficulties. They were plated in usual baths after a proper cleaning. Plating was conducted intermittently by removing articles from the bath and wire brushing them. (8d)

Contribution to the Experimental Study of the Influence of the Support or Cathode on the Structure of Electrolytic Deposits Obtained in Aqueous Solution. Albert M. Portevin & Michel Cymboliste. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1211-1218, discussion page 1218. Factors affecting the structure of electrodeposits are discussed. Crystalline continuity between basis metal and electrodeposit depends upon the contact between the electrolyte and the cathode and the rate of inception of crystalline centers. If this is large, in comparison to the number of the crystals of the cathode, the effect of the surface is nil, but if it is small, the number of the crystals of the cathode per unit of surface determines the crystal size of the deposit. 26 references. PRK (8d)

Bright Nickel Deposits (Glanznickelniederschläge) Eugen Werner. *Oberflächentechnik,* Vol. 13, Feb. 18, 1936, pages 40-42. Very bright, hard and dense Ni deposits are obtained with a current density of 1.5 amp./dm.^{2} They are preferably used for very irregular shapes which are also Cr plated. Such deposit cannot be made on Fe unless the surface has been previously highly polished. The additions to a bath for brightness are: agar-agar, dextrine, Turkish red, but at the same time correct conditions of the negative ion distribution and their amount in relation to the positive ions, current density and pH concentration must prevail. Practical conditions are discussed at length. Ha (8d)

Determination of the Phase Structure of Metallic Protective Coatings by Anodic Dissolution. A. Glazunov. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1262-1268. Discussion page 1286. Technique is described for obtaining the thickness of the whole coating and of intermediate layers, and the phases that make up the intermediate layer and thereby, indicate the method used to coat the base metal provided the basis metal is galvanically protected by the coating. 8 references. PRK (8d)



Electrolytic Rhodium Plating; a Promising New Method for Surface Refinement (Galvanische Rhodinierung; ein aussichtsreiches neues Verfahren der Oberflächenveredelung) *Oberflächentechnik,* Vol. 13, Mar. 3, 1936, pages 53-55. With the discovery of a new source of Rh in the Canadian Ni ores, production has increased to about 500 kg. Rh/yr., the present price being 4.50 RM for 1 g. as compared with 3.0-3.50 RM for Pt. Its advantage, even over Ag and Au plating, consists in its high chemical resistance; it is practically not attacked by aqua regia, lyes and salt solutions, and does not tarnish in S-containing atmosphere. Rh reflects the visible light, from 4000 to 7000 A.U. very uniformly, about 79%, while Ag reflects about 92% and Cr only 60-75%. Rh has a very white color and hardness considerably greater than that of Au, Ag, and Ni. It is used for plating jewelry. Rh plating is simpler than Cr plating. The cathode efficiency is 90%, the H development is, therefore, small; no injurious vapors are formed. Pt anodes 100 x 50 mm. and 0.04 mm. thick, in glass tanks are used. The bath operates at 20°-25° C. with a current density of 0.3-0.5 amp./dm.^{2}, at 2-2.5 volts at the start which rises to 3-4 volts towards the finish. The bath contains 2.5 g. Rh/l. and has excellent throwing power. A good, permanent deposit can be made in 3-6 min.; ½ g. Rh is deposited in 3 min. on 1 m.^{2} area. A Rh deposit cannot be removed by chemical or electrolytic methods, it must be polished off; great care in the preparation of the surface to be plated must, therefore, be taken to avoid waste. Electrolytic degreasing in a solution of 300 g. NaOH, 175 g. Na silicate and 15 g. NH_3 in 5 l. at 3-5 amp./dm.^{2} for a few minutes is recommended. Ag and Ag alloys, Ni, Cu, brass, Ni-Ag alloys, Au and the Pt metals can be plated with Rh directly; Cr, Fe, Zn, Sn and their alloys require the use of a suitable intermediary layer. Soldered pieces which are to be Rh plated should be soldered with Ag since Sn solder gives spots in the Rh bath. Detailed information on bath and procedure is lacking. Ha (8d)

Electrodeposition of Tungsten. *Steel,* Vol. 98, Mar. 9, 1936, page 40. Possibilities of electrodeposited W alloys are pointed out by summarizing briefly their properties. Some uses are suggested. MS (8d)

Pitting of Nickel Plate and How to Overcome It. *Steel,* Vol. 98, Mar. 23, 1936, pages 49-50. Easiest and best method of preventing pitting of Ni plate is to filter solution when freshly prepared and also at frequent intervals during its use. It is also important that pH of bath is not permitted to become so low (acid) that large quantities of H_2 are evolved. Agitation of work rod helps to dislodge H_2 bubbles. Addition of 1 pt. of 3% H_2O_2 to every 200 gal. of solution helps to prevent pitting. MS (8d)

Cadmium Plating. W. P. Barrows & K. D. Williams. *Journal American Society of Naval Engineers,* Vol. 48, Feb. 1936, pages 59-67. Typical plating baths of low and high Cd concentration are given and operating conditions indicated. If Cd plated parts are stored without provision for air circulation, a black discoloration occurs by decomposition of salts left on deposit from incomplete rinsing. Cd also corrodes to form a white powder in closed electrical systems at above normal temperatures by the acid gases given off by electrical insulation. Zn plate is free from both of these effects. Test results are summarized comparing the protective effect of Zn and Cd plated on cold rolled S. A. E. 1010 steel for outdoor atmospheric corrosion in various types of atmosphere. In industrial atmospheres Cd has ¾ the protective life of Zn and 90 Zn : 10 Cd alloy deposits have slightly longer life than either Cd or Zn. Other conclusions, 14 in all, are given. Tests for determining thicknesses of Cd and Zn plate are described. It is believed that rising price of Cd, due to extensive use in automotive bearings will increase the use of Zn for protection of ferrous metals. The protective value of Cd and Zn is about equal in most cases for equal thicknesses except where combustion products are present in atmosphere. The value of Zn for preventing attack on Al at a junction with Fe is considered as being equal to Cd plating on the Fe. WB (8d)

The Testing of Electrodeposited Coatings. L. C. Bannister. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 46, June 28, 1935, pages 701-704. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 134L/10. HBG (8d)

Electrodeposition of Zinc and Cadmium on Aluminum and Aluminium Alloys. B. K. Braund & H. Sutton. *Transactions Faraday Society,* Vol. 31, Dec. 1935, pages 1595-1611. Extensive tests were carried out on Zn and Cd plating of Al. The method of electrolytic cleaning that gave the most promising result was anodic cleaning in ammonia solutions. In general, electrodeposits were satisfactory only on plate material. Solutions of Na zincate reacted with Al alloys and deposited an adherent Zn deposit to form an excellent under-coating for further deposition of Zn and Zn could be deposited from sulphate baths of lower pH value on surfaces prepared in this manner. Methods of measuring current distribution in a zinc sulphate plating bath are discussed. 12 references. PRK (8d)

Theory and Practice of Chromium Plating; the Theory of the Mechanism of Chromium Deposition from Aqueous Chromic Acid Solutions (Theorie und Praxis der Verchromung. Zur Theorie des Mechanismus der Chromausscheidung aus wässerigen Chromsäurelösungen) III and IV. N. D. Birükoff & S. P. Makariewa. *Korrosion und Metallschutz,* Vol. 11, Dec. 1935, pages 265-278. Reviews and specifies the effect of physical and chemical factors on Cr deposition, and describes the different ways of formation of a protective layer, increase of Cr_3 concentration and presence of other cations. The principal basic fact in the electrolysis is that one molecule of reduced chromic oxide corresponds to one atom of deposited metal. In the reduction of CrO_3, Cr_2O_3 is first formed and then CrO. In electrolysis of chromic acid in presence of H_2SO_4, the chromic oxide originating at the cathode forms with H_2SO_4 and H_2CrO_4 a soluble salt, $Cr_{2m}(CrO)_{3m-n}(SO_4)_n$, which at higher H_2SO_4 concentration is transformed into $Cr_2(SO_4)_3$. This salt is reduced to chromous oxide which forms the intermediary protective layer and is partly oxidized by chromic oxide and partly reduced to metal. The chromic acid is reduced in the Cr deposition, not cathodically but chemically, so that it does not come into contact with the cathode. H_2SO_4 plays a very important part in the reactions as it forms soluble compounds with chromous oxide. The total reduction, $Cr^{VI} \rightarrow Cr^{III}$ must be proportional to the H_2SO_4 concentration. The complicated conditions are explained in detail, and in particular the importance of the current density. 18 references. Ha (8d)

8e. Metallic Coatings other than Electroplating

Tinning Copper Wire (Kupferdrahtzinnerei) CH. BERNHOEFT. *Zeitschrift für Metallkunde*, Vol. 27, Nov. 1935, pages 264-266. Cu wire which is to be insulated with rubber is first tinned to prevent the reaction of S with the Cu during vulcanization. The imperfect protection sometimes afforded by the Sn coating has been traced to mechanical imperfections in the Sn layer and to impurities in the Sn such as Cu. Contamination of the Sn bath with Cu as well as pin holes and flaws in the deposited layer may be caused by the acid used to clean the wire being carried into the bath. The best practice now calls for a thorough cleaning and drying of the wire before tinning. Of great importance also is the thickness of the Sn coating which may be controlled by adjusting the temperature of the bath, the length of dipping period, and the speed of travel of the wire. Tabular data showing the results obtained under various sets of conditions are presented. FNR (8e)

The Hot-tinning of Copper: the Attack of the Basis Metal and Its Effects. EDWARD J. DANIELS. *Journal Institute of Metals*, Vol. 58, Feb. 1936, pages 117-125 (Advance Copy No. 728). A study was made of the nature and extent of attack of Cu by Sn and solder during hot dipping. It was found that the alloy layer is invariably duplex, and consists of Cu_3Sn and Cu_6Sn_5. This layer breaks up under solvent attack by the Sn or solder and is removed from the basis metal almost as fast as it is formed. Contamination of the bath and coating from this cause increases rapidly with increase in temperature. The smoothness of Sn coatings is influenced greatly by the degree of the contamination and the quality of the basis metal. JLG (8e)

The Development and Control of Spangles on Galvanized Iron. Part 2, W. G. IMHOFF. *Metal Cleaning & Finishing*, Vol. 7, Mar. 1935, pages 121-126. Discussion of effect of steel on spangles. Analysis of steel of good galvanizing properties is given as C .10, Mn .31, S .037, P .07, Si .03, and an inferior galvanizing steel, as C .07, Mn .34, S .043, P .07, Si .016. The inferior steel having lower C is said to be oxidized and therefore a poor base for galvanizing. High Si and high Cu decrease adherence of the galvanized coating. Some causes of small spangles are presence of Mn oxide, slag and Fe oxide (in cast Fe), Al oxide, and segregations. Wrought Fe always galvanizes with small granular spangles. GBH (8e)

Metallizing—Its Scope and Limitations. J. W. HISHON. *Metallizer*, Vol. 5, Jan. 1936, pages 2-5, 15. A resume is given of the history, mechanism and fields of usefulness of metal spraying. The claim is made that metallizing is superior to welding for building up machine elements, since no preheating is required and no warping, distortion or internal stress is imparted. However, it does not add strength and repairing of fractures is outside its scope although some cracks may be repaired by spraying on the pressure side. Tensile strength of a metal is reduced, brittleness, hardness and compressive strength increased by metal spraying. Density is reduced about 10% due to porosity of sprayed metal. Zn, Te-Pb and "chemically treated Al" are recommended as sprayed coatings to protect against corrosion by water, steam, and brine. The deposit efficiency in best metal spraying practice varies from 60% with Pb to 95% with Ni. BWG (8e)

Electric Tinning and Galvanizing Furnaces (Ueber Elektro-Verzinn- und Verzinkungsöfen) H. FINNERN. *Elektrowärme*, Vol. 6, Jan. 1936, pages 27-30. Factors which determine the heat consumption, heat distribution and mechanical operation of tinning and galvanizing furnaces are discussed; operating data for 4 electric tinning installations for a production of 16 to 600 kg. per hr. are given. Ha (8e)

Striations in Tin Coatings on Copper. BRUCE CHALMERS & W. D. JONES. *Transactions Faraday Society*, Vol. 31, Sept. 1935, pages 1299-1303. When Cu is tinned by hot dipping, striations on the Sn coating appear, the appearance of which, under proper illumination, suggests a eutectic. Examination indicates that the pattern is due to alternate areas of Sn with smooth and with mottled or cellular surfaces. The effect is not due to etching. The regular reflections are definitely identified with a reflection from Sn and not from CuSn. The eutectic pattern is most readily produced if the Cu is fairly smooth, thoroughly degreased and adequately fluxed. Temperature changes of the Sn bath are without effect. The rate of crystallization governs the spacing of the striations. The pattern does not depend upon movement of the Sn while still molten. The pattern is not sensitive to normal changes in the Cu content of the Sn bath. The Cu content of the Sn coating was found to be 0.39%. The coating is largely eutectic in structure but contains hypo-eutectic areas. The suggested explanation is that periodic release of latent heat when solidification takes place after supercooling controls the direction of heat flow and also the orientation of the CuSn crystallites in the eutectic. PRK (8e)

The Mellozing Metal-Spraying Process. *Engineering*, Vol. 140, Dec. 27, 1935, page 704. Process developed by Mellowes and Co., Ltd., Sheffield. The metal to be sprayed is melted in a gas-fired crucible and then poured into a container within the metal-spraying pistol. A Bunsen-type burner keeps the metal liquid during the spraying process. The compressed air used for spraying is pre-heated. The thickness of the metal coating is 0.004" with one application and from 8 to 10 ft.^{2} of flat surface can be coated per min. Zn coating is very satisfactory as to corrosion resistance and a pure Sn coating is used for articles coming into contact with foodstuffs. Al-Si alloy is used when heat-resistance is needed. LFM (8e)

Stainless Coatings by an Improved Chromizing Process. *Iron Age*, Vol. 137, Mar. 12, 1936, page 35. Describes a chromizing process developed by Cooper Products, Inc., Cleveland, claimed to be an improvement over previous methods. Originally chromizing was done in H. Improvements consist in the use of ordinary commercial furnaces, chromizing billets or other semi-finished products, and rolling them into strip, sheets, wire, etc. As applied to mild steel, process produces a casing of ferro chrome, 25 to 30% Cr, claimed to have all the desirable properties of stainless steel. VSP (8e)

9. TESTING

9b. Physical & Mechanical Testing

W. A. TUCKER, SECTION EDITOR

Determination of Stresses in a Welded Seam by Means of Photo-elasticity (Sobre la determinacion de tensiones en un cordon de soldadura por la foto-elasticidad) J. BECH ARGELES. *Metalurgia y Construccion Mecanica*, Vol. 2, June 1935, page 6. The author presents a method for calculating the stresses in a weld seam. By means of photographs he shows the application of photo-elasticity in such a determination. FRM (9b)

Notched Bar Testing. S. L. HOYT. *Metals & Alloys*, Vol. 7, Jan. 1936, pages 5-7; Feb. 1936, pages 39-43; Apr. 1936, pages 102-106; May 1936, pages 140-142. Differentiates between notched and impact effects. The notched bar test measures a technological behavior of the material not an inherent material constant. Amount of notch effect to produce brittle behavior varies. Variables of test fall into 2 groups, those relating to geometry of bar and external conditions of test. Square bar seems best shape with 10 mm. a satisfactory size. Smaller radius of notch means lower energy absorption though tougher steels are less sensitive to this effect than brittler steels. Depth of notch is also of greater effect upon brittler steels. Increased striking velocity and lower temperature increase the sensitivity to notched effect more in brittler than in tougher steels. 2 types of fracture are noted in the test: fibrous, in which considerable deformation has taken place around the notch with high energy absorption and cleavage fractures, which are straight across normal to the axis of bar without deformation and with low energy. Increased severity of notch, improper (or overheating) heat treatment and low temperatures tend to produce cleavage fractures. Describes impact test with varying width of specimen (½ to 3 times the thickness) and increased sensitivity of test is gained by increased width of specimen. The utility of notched bar test rests upon its ability to detect unserviceable material. Test can be used to control a number of causes of brittle condition only a few of which can be controlled by other means. 11 such causes are mentioned. 20 references. WLC (9b)

Punch Testing (Ensayo de embutido) J. CASTELLS RUIZ. *Metalurgia y Construccion Mecanica*, Vol. 2, June 1936, page 1. Discusses the Persoz method of testing metal sheets to be used for stamping. FRM (9b)

Testing of Hoist Ropes (Die Prüfung von Förderseilen) O. VOIGT. *Archiv für Technisches Messen*, Vol. 5, Feb. 1936, pages T17-T18. Testing methods and apparatus to determine tensile, bending and torsional stresses are described. 16 references. Ha (9b)

9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals.

Endurance Tensile Tests and Endurance Bending Tests with Steel Bars with Flame-cut Faces (Ueber Dauerzugversuche und Dauerbiegeversuche an Stahlstäben mit brenngeschnittenen Flächen) OTTO GRAF. *Autogene Metallbearbeitung*, Vol. 29, Feb. 15, 1936, pages 49-57. Structural elements which have been cut by flame are often required to be machined or smoothed over on the edges (e.g. in the specifications of the German State Railways; American Welding Society). It was investigated how far this is justified, and from the very exhaustive experiments it was found that the strength of flame-cut pieces under often repeated tensile or bending stress was appreciably increased by planing or grinding of the flame-cut faces if the piece was prismatic without holes and machined on all sides. The degree of increase depended on the surface quality. Holes reduced the increase by machining; fracture started at the wall of the hole. Badly, irregularly cut pieces had somewhat lower endurance bending values than neatly, cleanly cut pieces. The annealing of flame-cut pieces increased the endurance resistance under often repeated loads very considerably. In general it was found that flame-cut bars showed endurance tensile and bending strengths which are fully sufficient for many purposes so that they can be used without further machining, especially when the range of variation of load is small and the magnitude of steady load is large. 13 references. Ha (9c)

Fatigue Testing of Metals (Les essais de fatigue des métaux) ROGER CAZAUD. *Revue de Métallurgie*, Vol. 33, Mar. 1936, pages 164-177. Summary of published data on fatigue testing. Among others the test specimen used by the Services Techniques de l'Aeronautique is described. 20 references. JDG (9c)

Influence of Concavity in Specimens of Reduced Section on the Endurance Limit in Bending (Einfluss von Hohlkehlen an abgesetzten Wellen auf die Biegewechselfestigkeit) E. LEHR & R. MAILÄNDER. *Archiv für das Eisenhüttenwesen*, Vol. 9, July 1935, pages 31-35. As part of a comprehensive investigation by the Verein deutscher Eisenhüttenleute on the mechanical properties of various C and alloy structural steels the effect of size and shape of fatigue specimens was studied. Three steels, a 0.28% C steel, a 0.32% C, 4.1% Ni, 1.2% Cr steel, and a nitrided steel containing 0.31% C, 2.6% Cr, 0.3% V and 0.3% Mo were tested and the sensitivity to notching determined in various sized specimens whose sections were reduced by means of fillets of differing radii of curvature. In general the larger specimens of both C and alloy steels gave lower endurance values than the smaller specimens and were more sensitive to "notching," as were also the harder steels. See also *Metals & Alloys*, Vol. 6, Dec. 1935, page 501L/10. SE (9c)

Leadership
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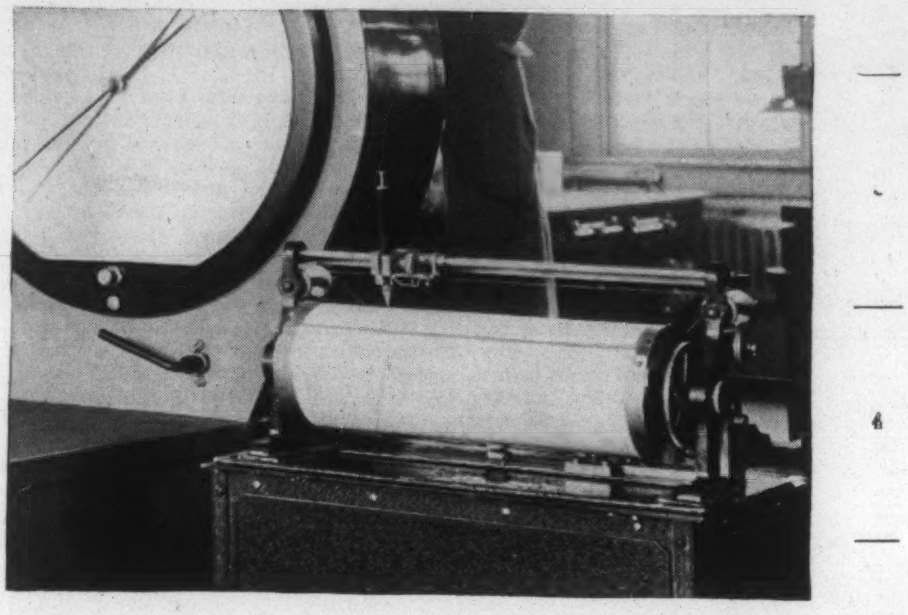

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A Study of the Fatigue Characteristics of Three Aluminium Specimens Each Containing from Four to Six Large Crystals. H. J. Gough & G. Forrest. *Journal Institute of Metals,* Vol. 58, Jan. 1936, pages 17-40 (Advance Copy No. 722). Specimens were subjected to alternating torsional fatigue. Each was tested at a constant range of applied torque. One specimen remained unbroken and the other 2 fractured. The observed changes in microstructure were related to the crystalline structure as revealed by X-rays and to the applied stressing system. Slip-band distribution of each specimen obeyed very closely the maximum resolved shear stress law, calculated for each crystal as if it alone occupied the entire specimen. Influence of boundaries on slip-band distribution was very slight. Cracking occurred in regions subjected to high values of resolved shear stress. These regions were often in close proximity to a boundary, but results indicated that influence of boundaries was very slight. It was established that fatigue cracking is not initiated at a boundary and that the general course of a crack does not tend to follow a boundary. The fatigue histories of the specimens revealed a fatigue limit, on the basis of 10^8 stress cycles, of about 1 ton/in.^{2} resolved shear stress, which differs but little from that of a single crystal of Al. (Note by H.F.M. It is evident that the fatigue strength of a single crystal or that of a specimen with only a few crystals is much lower than that of a multi-grained specimen of a given metal. This points to the desirability of studying effect of grain size in the range between the ordinary piece of metal, with grains either microscopic in size or barely visible to the unaided eye, and these specimens with only a few crystalline grains. This should not be taken as a criticism of the patient and necessary work of Gough and Forrest). JLG (9c)

Damping Capacity, A Factor in Fatigue. G. R. Brophy. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 154-185. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 502L/8. WLC (9c)

Internal Stresses and Their Effect on the Fatigue Resistance of Spring Steels. M. L. Becker & C. E. Phillips. *Iron & Steel Institute,* May 1936, Advance Copy No. 4, 16 pages. The work is part of an extended investigation carried out by the National Physical Laboratory on the effect of surface condition on fatigue resistance of spring steels. Methods of improving fatigue resistance of these steels is a part of the program. Preliminary stress measurements were carried out on a Si-Mn steel, a 0.6% C steel, and a 5% Ni steel case hardened. Quenching from tempering temperatures produced compressive stresses near the surface. Fatigue tests were made on Cr-V and Cr steels to determine the influence of such stresses on fatigue. A few tests were carried out to determine the influence of scragging (permanent deflection by controlled overloading) on the fatigue resistance of spring plates. Fatigue resistance of spring plates can be improved by "temper stressing", that is by quenching in water from the tempering temperature. This improvement is probably due to the presence of compressive stresses near the surface, which cause a reduction in the tensile stress on the tension side of the plates particularly at the roots of surface irregularities. The scragging of springs is beneficial to their fatigue resistance and this again appears to be due to residual compressive stresses in the tension surface. JLG (9c)

Effects of Solutions on the Endurance of Low Carbon Steel Under Repeated Torsion at 482° F. (250° C.) W. C. Schroeder & E. P. Partridge. *Transactions American Society of Mechanical Engineers,* Vol. 58, Apr. 1936, pages 223-231. The steel in a boiler is subject to static stresses and repeated stresses. The latter were investigated at 482° F. It was found that water caused failure more rapidly than air, and NaOH more rapidly than water. NaCl and Na_2SO_4 in water solution had about the same effect as water. Na_2CO_3 and tri-sodium phosphate in water acted the same as NaOH. Addition of Na_2CO_3 or Na_2SO_4 as excess solid to NaOH did not prevent the effect of the latter in repeated torsion tests. Addition of either Na or K chromate or $NaNO_3$ to NaOH solutions prevented the action of NaOH and the endurance of the specimen under test conditions could be brought up to a value at least as high as that for water alone. No relation could be established between endurance of the specimen and surface corrosion or pitting. Ha (9c)

Damage and Overstress in the Fatigue of Ferrous Metals. H. W. Russell & W. A. Welcker, Jr. *American Society for Testing Materials. Preprint* June 1936, 18 pages. Fatigue studies were made on some 12 ferrous metals including specimens of wrought Fe and of cast Fe. The "probable damage line" method developed by French was used and tests were made on both polished and notched specimens. The possibilities and limitations of this method are discussed, and determinations were made of the limits within which no damage was suffered by the metals, as shown by its ability to run subsequently at the virgin endurance limit of the metal for an indefinitely large number of cycles of stress. Some metals showed very low resistance to overstress, while certain notched specimens of wrought Fe were remarkably resistant to overstress, the probable damage line almost coinciding with the S-N diagram. No clear cut relations were found between damage-line test results and the results of other physical tests. However, some insight is given into the mechanism of notch formation and notch propagation. HFM (9c)

The Effect of the Addition of Lead on the Endurance Limit of a Certain Tin-base Bearing Alloy. John N. Kenyon. *American Society for Testing Materials, Preprint* June 1936, 4 pages. Using rotating-beam fatigue tests at 1750 and 3500 r.p.m. the addition of 4% Pb was found to improve slightly the endurance properties of an alloy of 80% Sn, 15% Sb and 5% Cu. After the alloy has been in service a long time a peculiar type of bearing failure sometimes occurs, and some explanation of this is offered. HFM (9c)

Report of the Research Committee on Fatigue of Metals. *American Society for Testing Materials, Preprint* June 1936, 4 pages. A progress report of the cooperative study of X-ray diffraction as a means of detecting incipient fatigue failure is presented as an appendix to this report. X-ray diffraction diagrams give some evidence of the beginning of plastic slip and possibly of the early stages of "creep", but so far have not given any clear cut evidence of the early stages of fatigue cracking. Various developments in fatigue of metals during the past year are very briefly noted, and attention is called to a difference between European and American laboratories in the technique of plotting S-N diagrams. New fatigue testing machines noted included the Haigh-Robertson fatigue machine for testing wire, the Gough machine for simultaneous bending and torsion, and a large fatigue machine of 200,000 lb. capacity built by W. M. Wilson at the University of Illinois. Several high values of endurance ratio (endurance limit: tensile strength) were reported, including one value of 0.8 for cast Fe. HFM (9c)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Formation of Stable Tungsten Carbide WC in Tungsten Steel. Gisho Kojima. *Kinzoku no Kenkyu,* Vol. 13, Apr. 1936, pages 127-141. In Japanese. η -phase in W steel is fairly stable in low C steel, but in high C steel it readily changes to stable WC on annealing at high temperature. WC is almost insoluble in austenite at temperatures not far above the critical range and consequently the dissolved C in the austenite decreases by annealing. The influence of annealing and added elements such as Ni, Cr, Mn, Si, and Co, on the formation of the stable carbide WC were investigated by measuring Rockwell hardness of quenched W steels. (1.25% C, 10.95% W and 0.82% C, 8.21% W) after annealing at several temperatures for several lengths of time. The most favorable annealing temperature for the formation of the stable carbide is 900°, but by heating to about 1000° for a few minutes the steel can be restored to its original state. The formation of the stable carbide by annealing is markedly retarded by the addition of less than 2% Ni, Cr, Mn, or Si, but on the contrary Co or more than 2% Mn promote its formation. The change of transformation point due to the formation of the stable carbide was also studied by the differential dilatometer. It rises slightly after annealing. KT (10)

Judging Cleanness of Steel by Deep Etching (Beurteilung der Stahlreinheit nach Tiefätzung) E. Houdremont & H. Schrader. *Archiv für das Eisenhüttenwesen,* Vol. 9, Dec. 1935, pages 273-275. To judge the inclusion content of steel by deep etching the sample should be quenched and drawn to eliminate obscuring effects of grain boundary etching. Deep etching then gives indications of P segregation in the longitudinal direction and of sulphides in the transverse direction. On the whole the evaluation of the inclusion content of a steel by deep etching should be checked by other methods. SE (10)

Effect of Mechanical Deformation on Transformation Rate of Polymorphous Metals (Der Einfluss mechanischer Deformation auf die Umwandlungsgeschwindigkeit polymorpher Metalle) E. Cohen, A. T. Cohen-de Meester & A. K. W. A. van Lieshout. *Proceedings Royal Academy of Sciences of Amsterdam,* Vol. 38, No. 4, 1935, pages 377-387. See "Rate of Polymorphous Transformations, III," *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 142L/1. EF (10)

The Metallic State (Consideraciones sobre el Estado Metálico) É. Jimeno. *Metalurgia y Construccion Mecanica,* Vol. 2, Apr. 1936, pages 11-15. The properties of metals as dependent on atomic and molecular arrangement in the structure, differences between crystalline and vitreous phases, plastic properties, and chemical properties as represented in the periodic system are explained. 10 references. Ha + FRM (10)

On Alpha Martensite in Carbon Steels. Zenji Nishiyama. *Kinzoku no Kenkyu,* Vol. 13, Feb. 1936, pages 37-40. In Japanese. Tetragonal or α martensite was previously proved by the author to be an interstitial solid solution of C in Fe, based on the fact that the axial ratio c/a of the tetragonal martensite increases with the C content. The radius of the sphere of action of Fe and C atoms was introduced into the calculation of lattice parameter and it was found that the calculated and previously observed values were in fair agreement. KT (10)

Grain Size and Grain Shape in Cast Metals (Korngrösse und Kornform in gegossenen Metallen) R. Mitsche. *Berg- und Hüttenmännisches Jahrbuch,* Vol. 84, Mar. 27, 1936, pages 4-13. Processes in production of metallic bodies by melting under different conditions were investigated. Lowest pouring temperatures produce irregular fine grain; increasing casting temperatures produce needle crystals, highest casting temperatures irregular coarse grain. The cooling velocity decreases with increasing temperatures and plays an important part in the formation of the structure; the undesirable needle crystallization can be avoided by casting tests with pure Al and Cu. 23 references. Ha (10)

Tests on the Diffusion of Carbon, Silicon, and Manganese in Solid and Molten Iron (Versuche über die Diffusion von Kohlenstoff, Silizium und Mangan in festem und flüssigem Eisen) M. Paschke & A. Hauttmann. *Archiv für das Eisenhüttenwesen,* Vol. 9, Dec. 1935, pages 305-309. Reproducible results were obtained for the diffusion of C in Fe at temperatures 900°-1250° C. Less reproducible results were obtained for Mn in Fe and the diffusion of Mn in Fe was considerably lower than for C in Fe. Only very approximate values for the diffusion of Si in Fe were obtained. SE (10)

Strength of Alumina Skin and Its Influence on Surface Tension of Molten Al (La Résistance Mécanique de la Peau d' Alumine et son Influence sur la Tension Superficielle du Métal Fondu) Albert Portevin & Paul Bastien. *Comptes Rendus,* Vol. 202, Mar. 23, 1936, pages 1072-1074. Al metal with a skin of Al_2O_3 has a surface tension of 840 dynes/cm.^{2}, while the non-oxidized metal surface has a value of only 420 dynes/cm.^{2} The Al_2O_3 skin has a tensile strength of 2 kg./mm.^{2}, which the authors believe accounts for the higher surface tension effect. FHC (10)

Two-stage Transformation in Iron and Steel. Kanzi Tamaru. *Kinzoku no Kenkyu,* Vol. 13, Apr. 1936, pages 156-160. In Japanese. The so-called two-stage transformations of A_1 and A_3 of Fe and steel were investigated by differential thermal and X-ray analysis. When the annealed specimen was analyzed thermally in a N_2 atmosphere, no heat change other than that due to the normal transformation was observed. When the specimen was heated in H_2 at 900°-1100° for over one hr., small amounts of abnormal heat absorption and evolution were observed, the former at 680° in heating and the latter at 890° in cooling in addition to A_1, A_2 and A_3. When the specimen was heated at 1150° for 4 hr. in high vacuum, H_2 was liberated, and such abnormality was obliterated. X-ray analysis showed that specimens treated in H_2 give broader diffraction lines than those untreated. From these facts author concluded that absorption of H by Fe causes stress in the Fe lattice. When the Fe was cooled from high temperature, a change took place among Fe atoms just before the A_3 transformation, consequently H_2 was liberated. This corresponds to the small abnormal heat evolution at 890° on cooling. The small heat absorption at 680° is considered to be the reverse phenomenon. KT (10)

Diffraction of Slow Electrons on Single Crystals of Zinc (Beugung langsamer Elektronen an Zinkeinkristallen) S. G. Kalaschnikow & I. A. Jakowlew. *Physikalische Zeitschrift der Sowjetunion,* Vol. 9, No. 1, 1936, pages 13-26. In German. The effect of temperature on the diffraction pattern was quantitatively studied and the results are compared with Debye's theory of X-rays. Electron velocities of 6-140 volts were used. The maxima observed are connected with the space lattice of Zn. EF (10)

X-ray Investigations of the Aluminum-lithium Diagram and Structure of the Intermetallic Compound AlLi (Röntgenographische Untersuchungen des Zustandsdiagramms der Aluminium-Lithium-Legierung und die Struktur der AlLi-Verbindung) G. Komovsky & A. Maximow. *Zeitschrift für Kristallographie,* Vol. 92, Dec. 1935, pages 275-283. Al alloys containing up to 20.5% Li were investigated by X-rays. Two phases, α and β, were established. No parameter change of Al due to addition of Li was observed. The solubility of Li in Al drops from 3.5% at 598° C. to 2.2% according to Assmann (*Zeitschrift für Metallkunde,* Vol. 18, 1926). The β phase was found to be the intermetallic compound AlLi which is cubic, has an edge length of 6.37 A.U. and 16 atoms in the unit cell. EF (10)

Nucleus Formation during Recrystallization. II. Nature of Incubation Period (Über die Keimbildung bei der Rekristallisation. II. Die Natur der Inkubationsperiode) M. Kornfeld. *Physikalische Zeitschrift der Sowjetunion,* Vol. 8, No. 5, 1935, pages 533-535. In German. 2 different interpretations of the nature of the incubation period in recrystallizing cold worked metals are discussed critically. It is shown which explanation agrees best with experimental evidence. (See also *Metals & Alloys,* Vol. 6, Apr. 1935, page MA 164R/5; June 1935, page MA 240R/1; Dec. 1935, page MA 504R/3). EF (10)

Kinetics of Recrystallization in Tin, Cadmium and Iron (Kinetik der Rekristallisation bei Zinn, Cadmium und Eisen) M. Kornfeld & F. Sawizki. *Physikalische Zeitschrift der Sowjetunion,* Vol. 8, No. 5, 1935, pages 528-532. In German. Genesis and growth of new crystals in cold worked Sn, Cd, and Fe is analogous to that in Al; i.e., an incubation period delays the formation of crystal nuclei and the latter grow at a constant rate, as found by Karnop & Sachs (*Zeitschrift für Physik,* Vol. 60, 1930, page 646). Recovery takes place before microscopic recrystallization. EF (10)

Theory of the Ordering Processes and of Diffusion in Solid Solutions of Copper and Gold. The Transformation Kinetics in Alloys. Fourth Communication (Theorie der Ordnungsprozesse und der Diffusion in Mischkristallen von Kupfer-Gold. Die Ordnungsumwandlungen in Legierungen. IV. Mitteilung) W. S. Gorsky. *Physikalische Zeitschrift der Sowjetunion,* Vol. 8, No. 4, 1935, pages 443-456. In German. A Cu-Au alloy with 50 at. % Au has an ordered tetragonal lattice below 300° C. The axial ratio a/c depends on temperature, due to degree of order. The kinetics of the process has also been studied at constant temperature, showing that a/c approaches a stable state as an asymptotic function. A theoretical approach to this process of increasing and decreasing order of the lattice is attempted whereby 3 different mechanisms are discussed critically; namely, diffusion of atoms via intermediary lattice positions, shifting of vacant lattice positions, and direct exchange of atoms. None of the hypotheses is in complete agreement with experimental evidence of the author and of Joost (*Zeitschrift für physikalische Chemie,* Vol. 16, Sec. B, 1932, page 123). EF (10)

Influence of Nickel on Solubility Limits of α-Phase of Cu-Al Alloys (Der Einfluss des Nickels auf die Löslichkeitsgrenzen der α-Phase der Cu-Al-Legierungen) V. Gridnew & G. Kurdjumow. *Metallwirtschaft,* Vol. 15, Mar. 6, 1936, pages 229-231; Mar. 13, 1936, pages 256-259. The effect of Ni upon the Cu-rich corner of the Cu-Al diagram was studied by X-rays, microscopic examination, and dilatometric measurement. 2% Ni raises the β-eutectoid from 570° to 605° C. and narrows the α field from 9.8 to 8.6 weight % Al, but no decrease of solid solubility with temperature was found. 4% Ni had no further effect on the eutectoid temperature or high temperature solubility of Al in the α phase. However, a slight decrease of solid solubility with temperature occurs. GD (10)

On the Possibility of Applying the Thomas-Fermi Method to the Problem of Metallic Cohesion. E. L. Feinberg. *Physikalische Zeitschrift der Sowjetunion,* Vol. 8, No. 4, 1935, pages 416-424. In English. Points out that the energy of the crystal calculated on the basis of the Thomas-Fermi method, when expressed as a function of the interatomic distance has no minima, which confirms the independent numerical calculations of Slater and Krutter. This means that the Thomas-Fermi method cannot explain the stability of the crystal lattice. EF (10)

Effect of Oxygen and Nitrogen on the Appearance of Veining in Ferrite (Einfluss des Sauerstoffs und Stickstoffs auf das Auftreten der Aederung im Ferrit) W. Eilender & H. Cornelius. *Archiv für das Eisenhüttenwesen,* Vol. 9, Nov. 1935, pages 263-264. In a series of very pure irons of varying N_2 and O_2 content there was no relation between degree of veining in ferrite and the content of these elements. It was concluded that α-veining resulted from stresses of γ-α transformation. The impurities played only a minor rôle. SE (10)

Should We Modify Our Interpretation of the Fe-Fe_3C Eutectoid Diagram? (L'Interpretation du Diagramme Eutectoide Fe-Fe_3C, Doit-Elle être Modifiée?) P. Dejean. *Journal de Physique et le Radium,* Series 7, Vol. 6, Dec. 1935, pages 525-531; discussion pages 532-536. The experimentally derived diagrams previously presented by Seigle do not seem to have been established under conditions sufficiently reliable to warrant modification of the classic theory of transformation in Fe and steel; the samples used were too small and cooling rates too rapid. More careful investigation shows that (1) the α-γ transformation of pure Fe is not spread, as Seigle claims, between the A_1 and A_3 points but occurs completely at the A_3 point, and (2) pearlite does not vary in composition to the extent maintained by Seigle, but is of reasonably constant composition, and its formation at the Ar_1 point is in complete conformance with the law of eutectoid formation. FPP (10)

Metallographic Applications of Electronic Rays and Their Physical Basis (Le applicazioni metallografiche dei raggi elettronici e le loro basi fisiche) R. Piontelli. *La Metallurgia Italiana,* Vol. 27, Dec. 1935, pages 817-825. First of a series of articles on electron rays. The theory of wave mechanics is briefly reviewed, and the electron microscope and its use are described. AWC (10)

A Classification of the Crystal Structures with Defect Lattices. Lester W. Stock. *Zeitschrift für Kristallographie,* Vol. 93, Mar. 1936, pages 285-311. In English. The "structure theory" requires that each set of equivalent positions be occupied and filled by chemically like particles. Recent crystal structure determinations have shown that for many substances this requirement is not fulfilled ("defect lattice") except for those designated in the paper as ideal solids. Defect lattices show all transitions from an ideal solid in which each particle forms a rigid lattice of its own to a dispersed state in which the lattice of one particle sort is completely destroyed. Structures with defect lattices have been classified on the basis of the manner in which one of these lattices depart from the "structure theory." The lattice of one or more particle sort is either (I) complete or (II) incomplete. One particle sort occupies (A) one set of equivalent positions (B) more than one set of the same coordination number or (C) positions of various coordination number, either (1) alone or (2) in common with other particles. A deformed lattice is classed as the first example of a defect lattice. The various types of lattice disturbances ("Fehlerordnungen") responsible for the electric conductivity and self-diffusion of solids have all been found by X-ray analysis. The positions of the larger symmetrical openings in a cubic body- and face-centered cell are tabulated. EF (10)

System Iron-cobalt-cobalt silicide-iron silicide (Das System Eisen-Kobalt-Kobaltsilizid-Eisensilizid) R. Vogel & K. Rosenthal. *Archiv für das Eisenhüttenwesen,* Vol. 9, Dec. 1935, pages 293-298. The ternary system Fe-Co-Si was studied thermally and microscopically in the region Fe-Co-Co Si-Fe Si and worked out with the aid of 6 sections through the Si end. The compounds Fe Si and Co Si form a continuous series of solid solutions. A ternary compound Fe Co Si is formed. SE (10)

System Iron-aluminum-carbon (Das System Eisen-Aluminium-Kohlenstoff) R. Vogel & H. Mäder. *Archiv für das Eisenhüttenwesen,* Vol. 9, Jan. 1936, pages 333-340. The Fe end of the Fe-Al-C system was studied by means of thermal curves and the microstructure. 6 primary phases forming on cooling were determined as follows: α, γ, ϵ, and δ three component solid solutions; graphite; and the compound Al_4C_3. Sections through the ternary system up to about 30% Al and 2.7% C are shown. SE (10)

System Iron-cementite-manganese carbide-manganese (Das System Eisen-Zementit-Mangankarbid-Mangan) R. Vogel & W. Döring. *Archiv für das Eisenhüttenwesen,* Vol. 9, Nov. 1935, pages 247-252. Diagrams of the systems Mn-Mn_3C and Fe-Fe_3C-Mn_3C-Mn were determined by thermal analyses and microscopic examinations. Mn and Mn_3C do not form continuous solid solutions with a liquidus maximum; instead a transition takes place between 1.5 to 2.9% C. and at higher C contents there is a temperature minimum. A transformation of Mn_3C at 1050° was observed. For the 3-phase system Mn-Fe_3C-Fe up to 60% Mn the diagram resembled that of Fe-Fe_3C; with higher Mn contents the relations were more complicated. SE (10)

Nitrogen Absorption During Grinding of Soft Iron (Stickstoffaufnahme beim Schleifen von weichem Eisen) H. J. Wiester. *Archiv für das Eisenhüttenwesen,* Vol. 9, Apr. 1936, pages 525-527. Microanalyses indicated that the ground surfaces of soft Fe may absorb N_2. The martensitic surface appearance which sometimes forms after grinding may be due to N_2 absorption. Apparently the heating during grinding activates the surface so that it can pick up N_2 from the air. SE (10)

Ideal and Real Crystal. Discussion (Ideal- und Realkristall, Diskussionsbeiträge) *Zeitschrift für Kristallographie,* Vol. 90, Mar. 1936, pages 161-228. Discussion of A. Goetz, W. Kleber, H. E. Buckley & D. Balarew on a previous paper by H. E. Buckley on the "**Mosaic Structure in Crystals,**" pages 161-166. (See also *Metals & Alloys,* Vol. 6, 1935, page MA 117 L/1) Discussion of A. Goetz, E. Orowan & M. J. Buerger on previous paper by M. J. Buerger on "**The Non-existence of a Regular Secondary Structure in Crystals,**" pages 167-173. (See also *Metals & Alloys,* Vol. 6, 1935, page MA 164 L/1) Discussion of D. Balarew, E. Orowan on the previous paper by D. Balarew on "**The Inner Absorption in Salt Crystals,**" pages 173-186. Discussion of A. Goetz on paper by A. H. Jay "**The Thermal Expansion of Silver, Quartz and Bismuth by X-Rays,**" pages 186-187. (See also *Metals & Alloys,* Vol. 6, 1935, page 122 R/8) Discussion of A. H. Fay on previous paper by A. Goetz on "**Group Phenomena in Metal Crystals,**" pages 187-188. (See also *Metals & Alloys,* Vol. 6, 1935, page MA 204 R/6) Discussion of E. Orowan on paper by G. I. Taylor "**A Theory of the Plasticity of Crystals,**" pages 188-191. (See also *Metals & Alloys,* Vol. 6, 1935, page MA 117 L/2) Discussion of D. Balarew, E. Orowan & A. Smekal on paper by A. Smekal "**Contribution to the Theory of Real Crystals,**" pages 191-216, (See also *Metals & Alloys,* Vol. 6, 1935, page MA 296 R/8) Discussion of L. Royer, D. Balarew & G. Kalb on previous paper by G. Kalb "**Vicinal Phenomena and Their Significance for the Symmetry of the Growth of Crystals belonging to Different Crystal Systems,**" pages 216-220. General Discussion to the problem "**Ideal and Real Crystal**" by M. Straumanis, P. Niggli & A. Smekal, pages 220-228.—It is impossible to give an adequate summary of the information, views, hypotheses, experiments, etc. referred to in these discussions. The original text must be consulted. About half of the discussions are in English and the other half in German. EF (10)

The State of the Rare Earth Elements in a Metal Lattice. V. I. Drozzina & R. I. Jaanus. *Physikalische Zeitschrift der Sowjetunion,* Vol. 9, No. 1, pages 72-80. In English. A study has been made of the relation between temperature and magnetic susceptibility of Ce and Pr. Magnetic moment and Curie temperature of Ce are $p = 11.4\ M_W$ and $\Theta = 6°$ K. respectively. The corresponding values for Pr are $p = 16.0\ M_W$ and $\Theta = 2°$ K. A comparison between the magnetic moments found experimentally and those theoretically derived shows that these elements are in the same state when incorporated in metal lattice as in trivalent chemical combinations. EF (10)

New X-ray Camera for Low Temperatures (Eine neue Röntgenkamera für tiefe Temperaturen). Barbara Ruhemann. *Physikalische Zeitschrift der Sowjetunion,* Vol. 7, No. 5/6, 1935, pages 572-582. A new structural principle is incorporated in the vacuum camera described. The sample, but not the film, is placed in a vacuum. Two designs of the camera, suited for different purposes, are discussed and illustrated. A small refrigerating machine, which can be placed easily on any vacuum camera instead of a Dewar vessel, is suited for attaining any temperature down to that of liquid hydrogen and to hold the temperature at ± 0.1°C. during the exposure of several hours. EF (10)

Spectral Emissivities, Resistivity and Thermal Expansion of Tungsten-molybdenum Alloys. P. N. Bossart. *Physics,* Vol. 7, Feb. 1936, pages 50-54. The spectral emissivities of 3 W-Mo alloys were measured directly by optical pyrometry. These were about 120% at 1300° K. to 110% at 2200° K. of the values which may be calculated from the rule of mixtures. For one alloy this result was compared to a similarly determined ratio of measured to calculated resistivities. By Drude's law the square root of the resistivity ratio should be the corresponding emissivity ratio. For temperatures from 1300° K. to 2100° K. the square root of the resistivity ratio was practically constant at 1.215 checking the emissivity ratio of 1.19 at 1300° K. only. The emissivities of W and Mo were measured. For the alloy 46.5 atomic % W both the resistivity-temperature and the thermal expansion-temperature relations were determined. The resistivity relation is compared with those of the constituents and seems to bear out the theory of Bragg and Williams that the extra increase of resistivities at high temperature is due to increased atomic disorder. HFK (10)

Atomic Arrangement in Metals and Alloys. W. L. Bragg. *Journal Institute of Metals,* Vol. 56, No. 2, 1935, pages 275-299; *Metal Industry,* London, Vol. 46, May 17, 1935, page 527. **Metals and Alloys.** *Chemical Trade Journal & Chemical Engineer,* Vol. 96, May 10, 1935, page 360. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 75R/5. HBG + MS (10)

Equilibrium Diagram Cu-Sn Alloys (Sur le Diagramme de Solidification des Alliages Cuivre—Étain) W. Broniewski, J. T. Jablonski & St. Maj. *Comptes Rendus,* Vol. 202, Jan. 27, 1936, pages 305-307. Thermal analysis confirmed Cu_4Sn, Cu_3Sn, and Cu_3Sn_2. FHC (10)

Equilibrium Diagram of Cu-Zn Alloys (Sur le Diagramme de Solidification des Alliages Cuivre-Zinc) Witold Broniewski, J. T. Jablonski & St. Maj. *Comptes Rendus,* Vol. 202, Feb. 5, 1936, pages 411-414. Prolonged annealing and improved methods of thermal analysis confirm the existence of the following compounds: CuZn, $CuZn_2$, $CuZn_6$. FHC (10)

Structure of Some Copper Alloys (Sur la structure de quelques alliages du cuivre) W. Broniewski. *Revue de Métallurgie,* Vol. 32, Dec. 1935, pages 649-657. Critical survey of equilibrium diagrams of Cu-Ni, Cu-Ag, Cu-Al, Cu-Zn, Cu-Sn, Cu-Au systems. 40 references. JDG (10)

Kinetic Differences Between Cast and Deformed Material (Kinetische Unterschiede zwischen gegossenem und vorverformtem Material) H. Bumm & U. Dehlinger. *Metallwirtschaft,* Vol. 15, Jan. 24, 1936, pages 89-90. Characteristics which differentiate cast from recrystallized metals are shown by a metallographic study of precipitation of Ag from Cu solid solution containing 6% Ag. Single crystals are formed from the melt and homogenized after making a ball impression in the sample. The area about the impression recrystallizes and precipitation treatments show much more rapid action in this zone. Agglomeration of the Ag precipitate is also more rapid in this area. Differences are attributed to increase of mosaic structure in the recrystallized state. GD (10)

Plastic Deformation and Hardness of Pb (Déformation Plastique et Dureté du Plomb) Marcel Ballay. *Comptes Rendus,* Vol. 202, Jan. 20, 1936, pages 222-224. Severely cold worked Pb of 99.984% purity was held at room temperature for 17 days and the penetration hardness compared with the same cold worked Pb held 1 hr. at 250° C. After 5 mins. application of the load, the Pb annealed at 250° C. appeared slightly harder than the Pb held at room temperature for 17 days. FHC (10)

Problem of Gas in Metals (Le Problème des Gaz dans les Métaux) G. Chaudron. *Usine,* Vol. 35, Jan. 30, 1936, page 37. The various forms in which gases can be retained by metals are classified: (1) Gases retained by adsorption, which decrease with temperature, this is noticeable only for CO. (2) Gases retained mechanically as inclusions, due either to sudden change of solubility of the gas because of temperature difference or of addition of metal (e.g. Mn in Al), or of reaction in the metal, e.g. solidification, reaction of C with FeO. (3) Gases retained in combination, e.g. Fe nitride in isolated pearls. The conditions under which these 3 forms occur are discussed and illustrated. Ha (10)

The Mechanism of Precipitation (Über den Verlauf Ausscheidungen) U. Dehlinger. *Zeitschrift für Metallkunde,* Vol. 27, Sept. 1935, pages 209-212. With discussion. Transformation and precipitation processes may be divided into 2 classes: (a) in which the transition from the initial to the final lattice is sudden and complete, and (b) in which the change of lattice type is gradual. The precipitation of Ag from Cu in cast single crystals and polycrystals is of the (b) type, but if the alloy has been worked and recrystallized the process is of the (a) type. Experiments have shown that particles of Ag in the cast material do not act as centers for reaction. The author proposes that such randomly distributed aggregates redissolve in favor of more effective nuclei, which form at the boundaries of mosaic blocks. The wider spacing of the mosaic in cast metal thus accounts for the slower rate of precipitation. The first material precipitated thus forms a skin over the mosaic blocks, which agglomerate on further annealing. This conception affords an explanation of the 3 hardness maxima found experimentally. The precipitation of Ag is autocatalytic in recrystallized samples, but the exact kinetics of this process is not clear. GD (10)

Nitrogen Content and Abnormality of Sintered Carbonyl Steel (Stickstoffgehalt und Gefügeanormalität der Sinterkarbonylstähle) H. Cornelius & H. Esser. *Archiv für das Eisenhüttenwesen,* Vol. 9, Jan. 1936, pages 367-368. Sintered carbonyl Fe was found to contain as much as 0.02% N_2. This N_2, however, did not appear to be the cause of the abnormal structure. SE (10)

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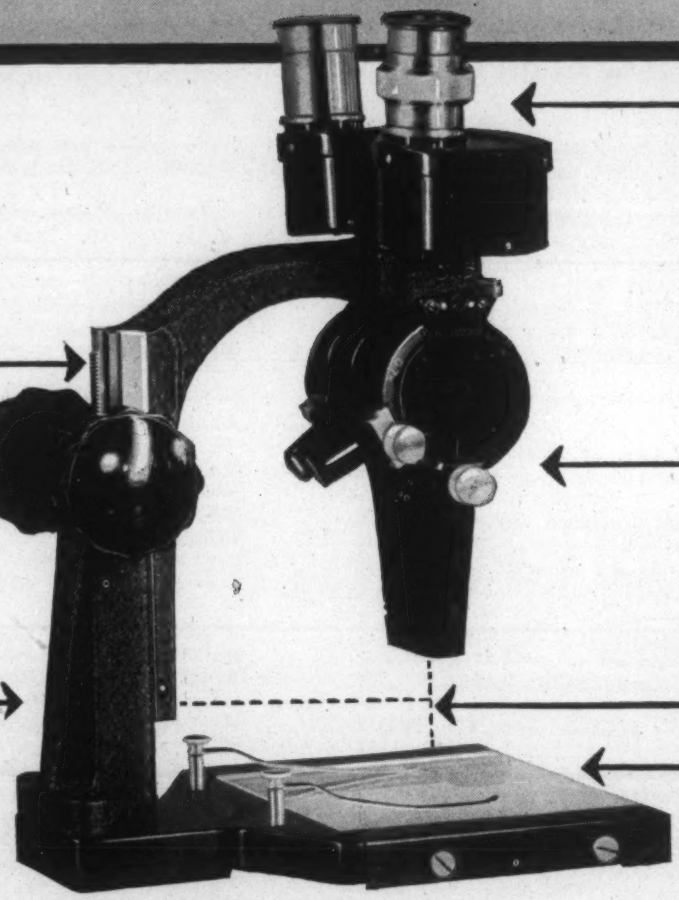

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Contribution of Metallography to Mechanical Engineering (Il Contributo della Metallografia alla Meccanica) G. GUZZONI. *Industria Meccanica,* Vol. 18, Jan. 1936, pages 6-8. Appraisal is made of important progress in mechanical engineering due to more intimate knowledge of properties of metals gained by metallography, and exemplified by an improved cast Fe produced by Ford.
Ha (10)

Aluminum-boron System (Beitrag zur Kenntnis des Systems Aluminium-Bor) W. HOFMANN & W. JÄNICHE. *Zeitschrift für Metallkunde,* Vol. 28, Jan. 1936, pages 1-5. Constitution of Al-B alloys up to 4% B was studied by microscopic, X-ray diffraction, and polarization-microscopic methods, wherefrom a diagram differing widely from that of Haenni (Revue de Métallurgie, Vol. 23, 1926, page 343) was derived. Compounds AlB_2 and AlB_{12} were identified. Both appear as thin hexagonal plates in the microstructure. AlB_{12} undergoes a peritectic reaction with the liquid (estimated composition 4% B) at about 1350° C. to form AlB_2 and liquid. The liquidus curve drops sharply from AlB_2-AlB_{12} peritectic to a reaction (peritectic or eutectic) at a temperature near the melting point of pure Al and at a composition between 0 and 0.2% B. No solid solubility of B in Al could be detected by lattice measurements of an alloy quenched from 600° C. The compound AlB_2 is hexagonal with one molecule per unit cell. Al atoms occur at 0, 0, 0 and B atoms at ⅓, ⅔, ½, ⅔, ⅓, ½. The lattice dimensions are $a = 3.00$ A.U. and $c = 3.24$ A.U. A third (hexagonal?) phase of unknown composition was observed growing upon and taking its orientation from the AlB_2 plates. 13 references.
FNR (10)

The Thickness of the Amorphous Layer on Polished Metals. H. G. HOPKINS. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1095-1101. Using Au with the surface ground smooth by light rubbing on 000 emery paper and final grinding of 4 minutes on 0000 emery paper—2 minutes in each of 2 directions at right angles—15 minutes polishing on clean chamois leather was sufficient to induce the polished layer. The surface structure of the specimen was investigated by electron diffraction after the manner of G. P. Thomson. The surface was removed by sputtering under standardized conditions to determine the depth of the polished layer. The thickness of the Beilby layer was found to be about 30 A.U. over much of the surface. There was a general increase in crystal size below the polished surface. 14 references.
PRK (10)

Study of Certain Aluminium-chromium Alloys. SOJI HORI. *Research Reports of the Sumitomo Metal Industries,* Vol. 2, Dec. 15, 1935, pages 351-372. In Japanese. Equilibrium diagram of Al-Cr system in the range 0-50% Cr was determined by thermal and microscopic analyses. 3 peritectic reactions were ascertained to take place at 1018°, 803° and 660° C., through which Al_2Cr, Al_4Cr, and a solid solution are formed, respectively. The limit of solid solubility of Cr in Al at 640° was determined to be 0.67-0.80%, and the value is constant as the temperature falls down to 470°. Rolled sheets of the alloys, containing up to 1.6% Cr. were subjected to mechanical and corrosion tests after heat treatments. The tensile strength increases slightly as Cr content increases. The alloy containing about 0.7% Cr showed remarkably high tensile strength on annealing. The phenomenon was assumed to be due to its higher recrystallization temperature. The alternate wet and dry corrosion test was carried out by use of artificial sea water for a month. The annealed alloy containing about 0.7% Cr was found to resist corrosion more than the annealed pure Al.
TS (10)

Roentgenographic and Electrical Investigations of the Cu-Au System (Röntgenographische und elektrische Untersuchungen des Cu-Au Systems) C. H. JOHANSSON & J. O. LINDE. *Annalen der Physik,* Series 5, Vol. 25, Jan. 1936, pages 1-48. In the 50% range, an ordered phase with 40 atoms in the elementary cell was found; the distribution of the atoms is rhombic. This phase CuAu II is obtained after tempering the alloy for a long time in the ranges of concentration of 36-47 and 53-65% Au at 200°-400° C., tempering under the same conditions in the concentration range 47-53% Au produces the previously known tetragonal phase CuAu I. Quenching this phase from 410°-420° C. changes it to CuAu II. The reasons for this transformation are discussed and ascribed to lattice deformation of not ordered phases. Concentrations of 65-80 at. % show cubic structure. The electric resistances have been determined for the whole system CuAu under different heat treatments. 44 references.
Ha (10)

The Constitution of the Tin-rich Antimony-tin Alloys. D. HANSON & W. T. PELL-WALPOLE. *Journal Institute of Metals,* Vol. 58, Feb. 1936, pages 79-90 (Advance Copy No. 725); *Technical Publications, International Tin Research & Development Council,* Series A, No. 31, 1936, 12 pages. Previous work on the Sn-Sb system is reviewed. Constitution of alloys up to 14% Sb was investigated by thermal and microscopal analyses, and electrical resistivity measurements. The portion of the liquidus investigated consists of 2 branches, the first corresponding to the separation of the Sn-rich α phase and the second of the cuboid δ phase. A peritectic occurs at 246° C. between δ and the liquid containing 9% Sb to form α containing 10.5% Sb. The solidus of the Sn-rich phase was determined by thermal and microscopical methods. The solubility of Sb in Sn decreases from 10.5% at 246° C. to 4% at 190° C. and to 3.5% at 100° C. The form of the solubility curve suggests that the mechanical properties of these alloys which form the base of the Sn-rich bearing metals might be sensitive to heat treatment. Their response to heat treatment is being investigated. JLG (10)

Copper-nickel-iron System (Das System Kupfer-Nickel-Eisen) W. KÖSTER & W. DANNÖHL. *Zeitschrift für Metallkunde,* Vol. 27, Sept. 1935, pages 220-226. Ternary diagram is developed from published data and new measurements of the magnetic susceptibility, electric conductivity, and thermal properties of the system. Electrolytic Cu and Ni and Armco Fe were used, the principal impurities being small amounts of C, Si, and Mn. The alloys showing the γ to α Fe transformation lie within the line drawn from the 28% Ni point on the Fe-Ni side to the Cu corner. The miscibility gap of the Fe-Cu system is diminished by additions of Ni being closed at 1220° C. by 27% Ni and at 25° by 82%. The nodal directions in the miscibility gaps and the decomposition limits are determined from Curie points and conductivity measurements.
GD (10)

Noble Metal Committee Report (Edelmetallausschuss) W. KÖSTER, JEDELE, H. BUMM & RAUB. *Zeitschrift für Metallkunde,* Vol. 27, Oct. 1935, pages 249-250. Brief description of current investigations of: (1) Au-Ni alloys, (2) influence of P and S on the technologic properties of the Pt metals, (3) Cu-Ag alloys, and (4) deoxidation of Ag-Cu melts.
FNR (10)

11. PROPERTIES OF METALS AND ALLOYS

Review of Physical Principles of Metal Plasticity (Ein Ueberblick über die physikalischen Grundlagen der Metallplastizität) H. SCHLECHTWEG. *Technische Mitteilungen Krupp,* Vol. 4, Mar. 1936, pages 29-38. The problem of the mechanism of polycrystalline materials and their behavior under stress has been treated from 3 points of view: (1) by neglecting the structure, the material is considered as a continuum; this permits developing theories useful in application of metals by the engineer. (2) The mechanistic behavior of the monocrystal is considered and explained by classical physics, and (3) the modern atomistic theory is applied to explain, with the help of quantum mechanics, the behavior of metals. Examples are treated under the 3rd point of view explaining creep, plasticity, formation of alloys, and movement of heat in the crystal lattice, and an attempt is made to calculate the properties of a multi-crystal from those of a monocrystal. The theory of G. J. Taylor for the propagation of a plastic gliding is explained. 60 references.
Ha (11)

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Valuation of Alloys with a Zinc Base (Valorizzazione delle leghe a base di Zinco) V. S. PREVER. *Industria Meccanica,* Vol. 18, Mar. 1936, pages 128-132. Zn alloys with Cu, Al, Pb, Fe and Sn, particularly as bearing metals, are reviewed from the special standpoint of Italian industry which has to economize in their consumption as almost all these metals must be imported. Several alloys now used in the Italian industry and their properties are described, and literature for these alloys is cited.
Ha (11a)

The Solubility of Lanthanum in Mercury from 0° C. to 50° C. W. GEORGE PARKS & JOSEPH L. CAMPANELLA. *Journal of Physical Chemistry,* Vol. 40, Mar. 1936, pages 337-342. La amalgams were prepared by direct heating of the metal with Hg and by the electroysis of $LaBr_3.H_2O$ in absolute ethyl alcohol. The solubility of La in Hg is reported at 0°, 12.5°, 25°, 37.5° and 50° C. In the temperature range from 0° to 50° C. the solubility is expressed by the equation.

$$\log N_2 = \frac{-1020}{T} - 0.4575$$

A brief discussion of the problem affecting the determination of the solubility of sparingly soluble metals is given. The low solubility of La in Hg indicates that La has a rather high internal pressure, approximately the same as that of Bi. From the general behavior of La amalgam it is assumed to be unsuited for precise e.m.f. work without considerable difficulty. 27 references.
EF (11a)

Experiments on Supraconductive Tantalum. K. MENDELSSOHN & J. R. MOORE. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, Mar. 1936, pages 532-544. The importance of magnetic threshold values in supraconductors, i.e. the magnetic field strength just sufficient to destroy supraconductivity, with regard to the thermodynamical behavior of the metal is explained. The threshold curves and magnetic penetration curves coincide for most metals with low melting points, but in Ta a discrepancy exists which is explained by thermodynamical behavior of small supraconductive regions. 11 references.
Ha (11a)

Nickel—Chromium Heat Resisting Alloys—Properties and Production Methods. A. M. C. MURPHY. *Metal Industry,* London, Vol. 47, Oct. 18, 1935, pages 387-390, 402. Discusses alloys of Ni, Cr, and Fe used in resistance materials. The 80 Ni-20 Cr received major consideration and its properties are compared with those of the cheaper alloy 65 Ni, 20 Fe, 15 Cr. Production of the 80/20 material is considered one of the most difficult metallurgical tasks of the present time. Careful attention is necessary from the charging of the melting furnace through to the last pass of the wire. Melting, casting, forging, hot-rolling, wire-drawing and annealing are considered. The article is illustrated by binary and ternary diagrams, tables and micrographs.
HBG (11a)

Artificial Radioactivity by Neutron Irradiation (Künstliche Radioaktivität bei Neutronenbestrahlung) I. W. KURTSCHATOW, G. D. LATYSCHEW, L. M. NEMANOW & I. P. SELINOW. *Physikalische Zeitschrift der Sowjetunion,* Vol. 8, No. 6, 1936, pages 589-594. In German. Artificial radioactivity of Pd, Re and Os after exposure to slow neutrons is quantitatively determined. EF (11a)

The Absolute Measurement of the Viscosity of Liquid Tin. A. J. LEWIS. *Proceedings, Physical Society,* Vol. 48, Jan. 1936, pages 102-110. Includes discussion. The viscosity of molten Sn between 235° and 330° C. in an atmosphere of H was determined by observing the time taken for a known volume to flow through a vertical capillary tube under a known pressure difference. Values ranged from 0.0195 poises at 235° C. to 0.0160 poises at 330° C. These agree well with the measurements made by Stott with a rotating disc and by Sauerwald and Töpler by the capillary flow method.
JCC (11a)

The Measurement of Modulus of Torsional Rigidity of Ni-Cu Alloy. RIMPEI KIKUCHI. *Kinzoku no Kenkyu,* Vol. 13, Feb. 1936, pages 41-43. In Japanese. The modulus of torsional rigidity of Ni-Cu alloys was measured by Poggendorf's method. The rigidity of cold-drawn wire is greater than annealed wire; it increases with Ni content. Anomalies in the rigidity are found at 60 and 85% Ni. The former corresponds to the anomaly in magnetic property. KT (11a)

Notes on Failures of Chilled Iron Cast Rolls Containing Chromium and Molybdenum. J. SELWYN CASWELL. *Sheet Metal Industries,* Vol. 9, Dec. 1935, pages 749-752. Published in the *Proceedings of the Institution of Mechanical Engineers,* See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 508L/9.
AWM (11a)

Aluminum Alloys—Patent List (Aluminium-Legierungen, Patentsammlung) A. Grützner & G. Apel. Supplement to section on aluminum in Gmelin's Handbuch der anorganischen Chemie. Part 2. Verlag Chemie, Berlin, 1936. Boards, 7 x 10 inches, pages 343-868. Price 54 RM.

Similar to part 1, issued earlier in 1936 and reviewed in *Metals & Alloys*, Vol. 7, May 1936, page MA 256R/9. This completes the listing of all patents on Al alloys in the chief industrial countries up to May 1935. A feature of this volume is a list of trade names or numbers by which commercial alloys are designated by various makers and the composition of the alloys compiled by A. von Zeerleder. This occupies 14 pages and resembles Campbell's A.S.T.M. list. This list is an extremely useful one. H. W. Gillett (11a) -B-

Aluminum Handbook (Aluminium Taschenbuch) 6th Edition. Aluminium-Zentrale G.m.b.H., Berlin, 1936. Paper, 4½ x 6½ inches, 377 pages. Price 4 RM.

Aluminium Taschenbuch, which is now in the sixth edition, is a handbook published for the information of German users of Al. This volume represents a 50% increase in pages over the previous edition. It covers a wide variety of subjects, such as historical and statistical data on Al, the composition and properties of commercial Al alloys, the physical testing and chemical identification of Al alloys, data on casting, cold working and heat treatment, methods of machining and joining, surface treatment and chemical properties. It includes an extensive section on the use of Al in the electrical industry, and a variety of tables of general interest to chemists and engineers. The reader of German should find this Handbook very useful, for example, in finding the approximate chemical composition of Al alloys known only by their commercial names. The tables of properties of Al alloys are quite extensive and detailed. While the treatment of the subjects is generally limited by the size of the book, it contains a surprising amount of information, most of which appears to be up-to-date and well selected. J. D. Edwards (11a) -B-

Magnesium and Ultra Light Alloys (Le Magnésium et les Alliages Ultra-Légers) Paul Bastien. *La Technique Moderne*, Vol. 27, Nov. 1, 1935, pages 702-708. First section studies chief sources of supply. Industrial method for obtaining and purifying Mg are reviewed. Second section is devoted to following subjects: (A) Physical and chemical properties of Mg. (B) Various types of ultra light alloys actually used. Pure commercial Mg gives as cast: Tensile 10-12 kg./mm.^{2}, elongation (on 100 mm.) 6%; as drawn wire: Tensile 18-22 kg./mm.^{2}, elongation (on 100 mm.) 8-12%. Equilibrium diagrams of binary systems: Mg-Zn, Mg-Al, Mg-Cu and ternary alloys: Mg-Al-Zn and Mg-Al-Cu are given and discussed. Commercial alloys are: (1) Mg-Al alloys containing 4-6% Al which are known as Dow-Metal and give as cast in sand: Tensile 15-17 kg./mm.^{2}, elongation (on 100 mm.) 4-5%, Brinell 45; as cast in metal mold: Tensile 16-18 kg./mm.^{2}, elongation (on 100 mm.) 5-8%, Brinell 55; as drawn wire: Tensile 27-29 kg./mm.^{2}, elongation (on 100 mm.) 15-18%, Brinell 50. (2) Mg-Zn and Mg-Al-Zn which are known as Elektron alloys and are much used in aircraft engineering. (3) Mg-Cu and Mg-Al-Cu alloys which comprise 2 classes, the first with Al + Cu less than 6% which are somewhat similar to the above but with a thermal conductivity slightly higher, the second with Al + Cu more than 8% and less than 15% which have a high thermal conductivity making them particularly suitable for piston manufacture. Cu reduces corrosion resistance of Mg. In Mg alloys containing more than 8% and less than 15% Cu + Al, those containing 8-12% Cu with little Al are forgeable whereas those containing 8-12% Al with little Cu are not forgeable. Thermal expansion of Mg is given as 25.8 x 10^{-6} (c.g.s. units) and that of common alloys as 24-28 x 10^{-6} depending on the composition. FR (11a)

Aluminum-Magnesium Alloys (Alliages aluminium-magnésium) Pierre Vachet. *Revue de Métallurgie*, Vol. 32, Dec. 1935, pages 614-626. Accurate space lattice determinations showed that annealing for 16 hours retains in solution about 8% Mg. Drawing quenched alloys precipitates the excess of Mg above 8% in 2 hrs. at 200° C., but 24 hours are required to bring it down to 4.5%. Only alloys in solid solubility range were investigated, though low rate of diffusion almost always results in β phase precipitation. Dilatometric investigation indicated a practical similarity between curves obtained with alloys containing more than 11% Mg and no Mn and 9% Mg with 0.5% Mn both in quenched and annealed state. Under these limits there are observed two anomalies which cannot be explained, unless they are allotropic transformation of β phase. For alloys containing less than 8% Mg quenching and annealing treatments produced the same properties. Heating cold worked metal between 150° and 450° C. softened it in 5 minutes. When Mg is above 8% precipitation of β phase after treatments reduces ductility of the alloys. Aging following quenching from 450° C. does not occur when Mg is below 8%. With Mg above this content aging does not take place at room temperature or at 75° C., is slow at 150° C., but reasonably fast at 200° C. Alloys age proportionally to the Mg content. Impact values are unusually high for light alloys, 6-9 kg.-m/cm.^{2}, and they are improved by quenching. Fatigue testing gave fatigue limit of about 12 kg./mm.^{2} for 12% Mg alloy. Salt spray corrosion resistance of the alloys is good and is improved by treatments retaining β phase in solution. Mn addition does not have any effect on corrosion resistance. Sand cast Al-Mg alloys have tensile strength of 16-20 kg./mm.^{2}; their elongation drops from 13% for a 3% Mg alloy to zero for 12% Mg alloy. Quenching them in oil at 425° C. gradually increases tensile strength from 16 to 32 kg./mm.^{2}. Their elongation passes through a minimum at 8% Mg content and reaches 15-20% for a 12% Mg alloy. Addition of 0.5% Mn increases tensile strength by 2-3 kg., the effect being more pronounced with higher Mg content. A 0.5 Mn, 12% Mg and 87% Al alloy has the best casting properties of the series and after quenching has a tensile strength of 33 kg./mm.^{2} with an elongation of 12%. These properties can be obtained when the molten metal is protected from oxidation and nitriding by a flux such as carnalite and from the action of the moisture in the sand. In the latter case addition to sand of boric acid is quite beneficial. For heat treating a heating for 24 hours at 425° C. and quenching in oil is recommended. JDG (11a)

Elastic Secondary Effects in Arranged Copper-Gold Alloys. Elastic Hysteresis of the First Order (Die elastische Nachwirkung in geordneter Kupfer-Gold Legierung. Elastische Nachwirkung erster Art) W. S. Gorsky. *Physikalische Zeitschrift der Sowjetunion*, Vol. 8, No. 5, 1935, pages 562-571. In German. The object of this investigation was to check on the previously advanced theory of the author by determining the elastic hysteresis in the arranged Au-Cu lattice. In polycrystalline material a hysteresis of 60-100% of the elastic deformation could be found as of the effects was close to the predicted ones. The speed of this process increases with rising temperatures. EF (11a)

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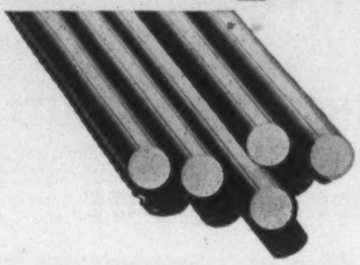

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Duralumin and Related Alloys Properties and Heat Treatment Procedure. HAROLD SILMAN. *Metal Industry,* London, Vol. 47, Aug. 30, 1935, pages 199-201. The discovery of duralumin, its early history and development are briefly outlined. The mechanism of age-hardening is discussed. The 3 stages in which duralumin alloys are treated are summarized as: (1) solution heat treatment, whereby the soluble constituents are brought into solid solution; (2) rapid quenching, for the purpose of retaining these constituents in a metastable, supersaturated solution; and (3) aging, during which the dissolved compounds are gradually precipitated. The hardness of the alloy is dependent upon the state of division of the precipitated particles. Certain precautions relative to temperature control and treatment of the nitrate-bath, used in solution heat treament, are included. The composition of "standard" duralumin is given as 4% Cu, 0.5% Mg, 0.5% Mn, together with the Fe and Si normally present in commercial Al. The effects of variation of the Cu-content, of additions of Si, Mn, and Mg are indicated. The methods of heat treatment used for these modified duralumin alloys, the characteristics of these alloys and commercial applications are briefly discussed. Mention is made of the "Y" alloy, consisting of Al plus 4% Cu, 2% Ni, and 1.5% Mg, its advantages, method of heat treatment and commercial applications. HBG (11a)

The Free Energies and Vapor Pressures of the Alkali Metals. A. R. GORDON. *Journal of Physical Chemistry,* Vol. 4, Feb. 1936, pages 100-102. The free energies of the diatomic alkali vapors are calculated from spectroscopic data and the equilibrium constants for dissociation into the monoatomic form are computed. With the aid of these constants, equations are deduced from the observed vapor pressures obtained by various investigators which give the partial pressure of atoms and molecules in the saturated vapors for temperatures up to the normal boiling point. In the case of Na and K, the entropy of the solid metal is computed from the vapor pressure equation and is compared with that predicted by the third law of thermodynamics. EF (11a)

Precipitation-hardenable Bronzes of a Copper-nickel-tin Base (Ueber aushärtbare Bronzen auf Kupfer-Nickel-Zinn-Grundlage) E. FETZ. *Giesserei,* Vol. 22, Dec. 6, 1935, pages 604-611. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 201L/5. Ha (11a)

Characteristics of Nickel-Silver Alloys—Working Properties and Applications. *Metal Industry,* London, Vol. 48, Jan. 3, 1936, pages 3-4. This article is an abstract of the publication "The Properties and Uses of Nickel Silver", a publication that may be obtained free, upon request, from Henry Wiggin & Co., Ltd., Thames House, Millbank, London, England, S W I. HBG (11a)

Adhesion of Two Metal Surfaces in Vacuum and the Lowering of Adhesiveness by Certain Gases (Ueber das Haften zweier Metallflächen aneinander im Vakuum und die Herabsetzung des Haftens durch gewisse Gase) R. HOLM & B. KIRSCHSTEIN. *Wissenschaftliche Veröffentlichungen aus den Siemens-Werken,* Vol. 15, Dec. 31, 1935, pages 122-127. A measuring method was developed by which the adhesion between 2 metal surfaces could be measured in terms of the angle by which the specimen must be inclined before sliding starts. In some cases even a vertical position did not cause sliding; this was called sticking, in opposition to adhering when sliding takes place. Ni-Ni, Pt-Pt, Ni-Pt and graphite-Ni were used. In a vacuum and chemically inert gases (N_2 and Ar), the annealed metals stick strongly together. In presence of O, H and vapors of benzene, toluol and alcohol, sliding takes place; the respective angles were determined. The reason for sliding is seen in the formation of a film on the metal, in the absence of which sticking may take place. Ha (11a)

Theory of Elastic Secondary Effects in Solid Solutions of Random Atom Distribution. Elastic Secondary Effects of Second Order (Theorie der elastischen Nachwirkung in ungeordneten Mischkristallen. Elastische Nachwirkung zweiter Art) W. S. GORSKY. *Physikalische Zeitschrift der Sowjetunion,* Vol. 8, No. 4, 1935, pages 457-471. In German. It is shown that the existing theories interpreting elastic hysteresis on the basis of uneven plastic deformation are not completely satisfactory. A new theory is advanced ascribing the hysteresis phenomena in solid solutions to a combined effect of diffusion and uneven stresses. The 2 cases of solid solutions, i.e. "penetration solution" and "subtraction solution" are investigated. It is shown that the elastic hysteresis can be increased up to 50% of the elastic deformation. Evaluating the rate of this process, it is demonstrated that secondary effect becomes extremely slow in single crystals with thicknesses of from 10^{-2} to 10^{-4} mm. An attempt is made to interpret the hysteresis in polycrystalline metals and alloys on the basis of diffusion. EF (11a)

Mechanical Properties of Tin Base Alloys (Propriétés mécaniques des alliages à base d'étain) D. J. MACNAUGHTAN & B. P. HAIGH. *Revue de Métallurgie,* Vol. 33, Jan. 1936, pages 7-13; *Technical Publications of the International Tin Research & Development Council,* Series A, No. 26, 1935, 12 pages; *Metal Industry,* London, Vol. 47, Nov. 1, 1935, pages 441-444, 448. This paper was presented to the International Congress of Mining, Metallurgy and Applied Geology Oct. 24, 1935. The authors state that while in some circumstances the low mechanical strength and high ductility of tin are an advantage, in other cases, as in pewter, pipes that must withstand pressure, solder and bearing metals, reenforcement by some other method is necessary. In the preliminary work on bearing metals undertaken for the International Tin Research and Development Council, a study has been made of the mechanics of the combination of layers of soft white metal on rigid liners. The work began by a study of the physical properties of various Sn-alloys for the purpose of selecting the most promising materials to be tested later in conjunction with suitable backing material. The methods of testing used are discussed. They include tension and compression testing, hardness, fatigue tests, and creep at elevated temperatures. The influence of time in "creep" and "self-annealing" is of major importance in the practical use of white metal alloys. In the study of the white metals, in direct contrast to the methods usually used in testing other metals, a technique was developed in which creep and self-annealing are revealed in their full importance. The results obtained in a systematic study of the effect of additions of different alloying elements on the mechanical properties of tin are considered. 5 references. JDG + HBG (11a)

Plastic Deformation and Age-Hardening of Duralumin. P. L. TEED. *Engineering,* Vol. 141, Mar. 20, 1936, pages 320-321. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 202R/10. VSP (11a)

■ 11b. Ferrous ■

V. V. KENDALL, SECTION EDITOR

Cooperative Study of a Stable 18 Cr 8 Ni Steel Without Stabilizing Additions. Progress Report. *Transactions American Society of Mechanical Engineers,* Vol. 58, Feb. 1936, pages 115-116. A few preliminary figures of the test still in progress with this austenitic steel are given. No appreciable loss of ductility nor impairment of physical properties was found regardless of the time or temperature of heating, or whether the specimen was stressed or not. The discrepancy of this result with that on some other material is commented on. Ha (11b)

Heat Conductivity of Pure Iron and Commercial Steels (Die Wärmeleitfähigkeit von reinem Eisen und technischen Stählen) F. BOLLENRATH & W. BUNGARDT. *Archiv für das Eisenhüttenwesen,* Vol. 9, Nov. 1935, pages 253-262. A correlated abstract of the existing data on heat conductivity for pure Fe and C and alloy steels. Good average values can be given for the heat conductivity of plain C steels at room temperature. The data on the alloy steels are fragmentary and inconsistent and show only qualitatively the effects of the different alloying elements. Values of heat conductivity of several commercial type steels are given. 38 references. SE (11b)

Tough Cast Iron, Properties and Production in the Cupola Furnace (Fonte resistante, Proprietes et Fabrication au Cubilot) GUY HENON. *Usine,* Vol. 45, Feb. 13, 1936, page 27. The composition of this remelted cast Fe is 2.8-3.2% C, 0.6-0.8% Mn, less than 0.3% P and less than 0.008% S; it has a high modulus of elasticity, takes a fine polish after machining, has high wear resistance and dense structure with absence of physical defects. The Si content must be adjusted according to the thickness of the pieces to be cast:

average thickness in mm.	average Si content in %
6-10	1.80
10-15	1.65
15-25	1.50
25-35	1.35
35-45	1.20

The charge should be made up in such manner that the material does not acquire any hereditary properties; this is realized by using 25% each of scrap of same manufacture, fine-structure cast Fe of determined composition, slugs half steel and half hematite, and ordinary hematite castings. Ha (11b)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

Volatilization Velocity of Metals in a Gas Atmosphere (Die Verdampfungsgeschwindigkeit der Metalle in einer Gasatmosphäre) J. M. A. VAN LIEMPT. *Receuil Travaux Chimiques des Pays-Bas,* Vol. 55, Jan. 15, 1936, pages 1-6. For metal wire the following formula expressing the volatilization speed in a gaseous atmosphere has been derived

$$\frac{V}{V_r} = 1 - \frac{2}{\pi} \text{arc sin} \left(\frac{1}{1 + \frac{3.4}{r.d_g.d_m.p\ 10^{19}}} \right)$$

wherein V = volatilization speed in gas atmosphere, V_r same in vacuum, r = half of wire diameter in cm., d_g = diameter of gas atom in cm., d_m = diameter of metal atom in cm., p = gas pressure in cm Hg at 20° C. The formula is in satisfactory agreement with experimental results. At higher pressures, divergencies occur which are easily interpreted. EF (12)

Non-Ferrous Metals in Relation to Prolonged Stress—A Review of Recent Researches. *Metal Industry,* London, Vol. 47, Sept. 6, 1935, pages 223-227. Tronton & Rankine, Phillips & Andrade are considered as pioneers in the study of "creep" on non-ferrous alloys. The work of Andrade was the most comprehensive and resulted in important conclusions. Flow of metals was found to be (1) instantaneous deformation, (2) temporary, progressing as the cube root of time, or (3) permanent, characterized by steady increments of length per unit flowing length. This was designated as "viscous" but would now be called "creep." More recent investigators have shown the early generalization to be inadequate. Rosenhain & Ewen found 2 types of deformation, viz. movement by crystalline slip leading to transcrystalline fractures and grain boundary movement leading to intercrystalline fractures. Marked differences in behavior were shown in creep tests for rolled and cast material. Hot and cold rolling, temperature of testing, method of fabrication, period of aging, as well as the composition of the alloys studied, appeared to be governing factors in creep testing. The importance of ductility is indicated. The work of various investigators on Pb, single crystals of Pb, of Al-alloys, of age-hardening alloys and Sn-bronzes are discussed. Creep is compared with Brinell hardness tests. 35 references. HBG (12)

2 **Hall Effect in Nickel on Passing the Curie Point (Halleffekt in Nickel beim Oberschreiten des Curiepunktes)** I. K. KIKOIN. *Physikalische Zeitschrift der Sowjetunion,* Vol. 9, No. 1, 1936, pages 1-2. In German. The temperature relation of the Hall effect in Ni is investigated up to the temperature of the Curie point. Simultaneous measurement of the magnetization on the same sample yielded the "true Hall coefficient R_1" whose absolute magnitude and relation to temperature is given. Comparison with results of other investigations extending beyond the Curie point showed no marked break point at the Curie temperature. A tentative explanation is offered and tests on Ni-Cu alloys are announced. EF (12)

3 **Materials for Steam Pipes Used at High Temperatures (Werkstoffe für Dampfleitungen mit hoher Temperatur)** WILHELM PAUL. *Die Wärme,* Vol. 58, Dec. 21, 1935, pages 839-843. Strength, elongation, and creep resistance of 3 C, Mo, Mo-Cu and Cr-Mo steels at 20°-550° C. (600° C.) are tabulated. Effect of addition of 0.5% of C, Ni, Si, W, Co, Mn, Cr, Cu, Ti, V, Mo to 0.1% C steel on physical properties at 400° and 500° C. and additional costs in RM/ton are graphically shown. Creep resistance curves of 0.1% C-0.5% Mn steel with and without variously proportioned additions of Mn, Si, Cu, Mo, Cr (analyses given) are compared with the German standard structural steel St 37. EF (12)

4 **Seizing of Threaded Joints at Elevated Temperatures (Das Festfressen von Schraubenverbindungen bei höheren Temperaturen)** H. VOLLBRECHT. *Archiv für das Eisenhüttenwesen,* Vol. 9, Feb. 1936, pages 397-404. The seizing of threaded joints of various C, Cr-Mo, austenitic Cr-Ni, and nitrided Cr-Al-Mo steels on heating to 500° C. was studied. As oxidation occurred the frictional values increased. In threaded joints the tendency to seizing diminished, the smaller the difference in surface hardness between the nut and bolt and the thinner the oxide layer. When the oxide layer was less than 150 μμ thick no seizing occurred. Surface pressure had no effect on seizing. SE (12)

5 **Mechanical Testing at Elevated Temperatures (Les essais mécaniques à chaud)** JEAN GALIBOURG. *Revue de Métallurgie,* Vol. 33, Mar. 1936, pages 157-163. Description of methods used at present. 21 references. JDG (12)

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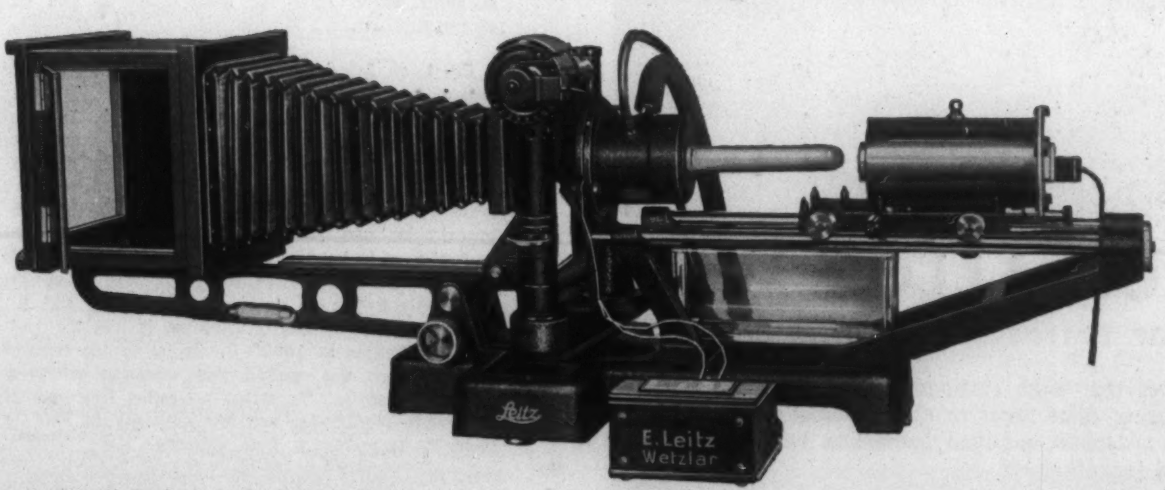

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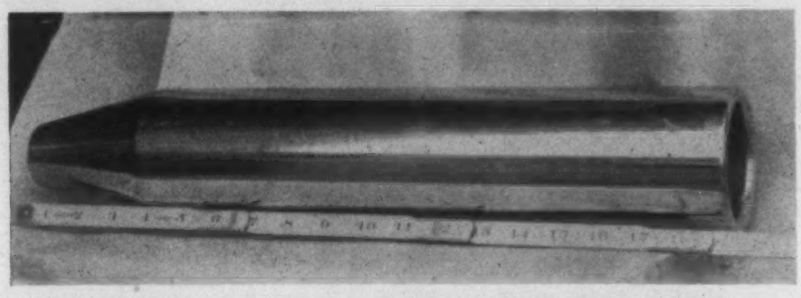

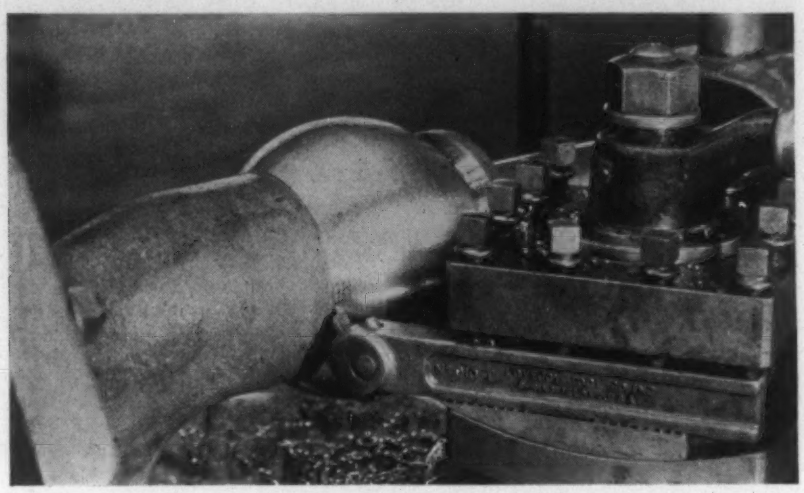

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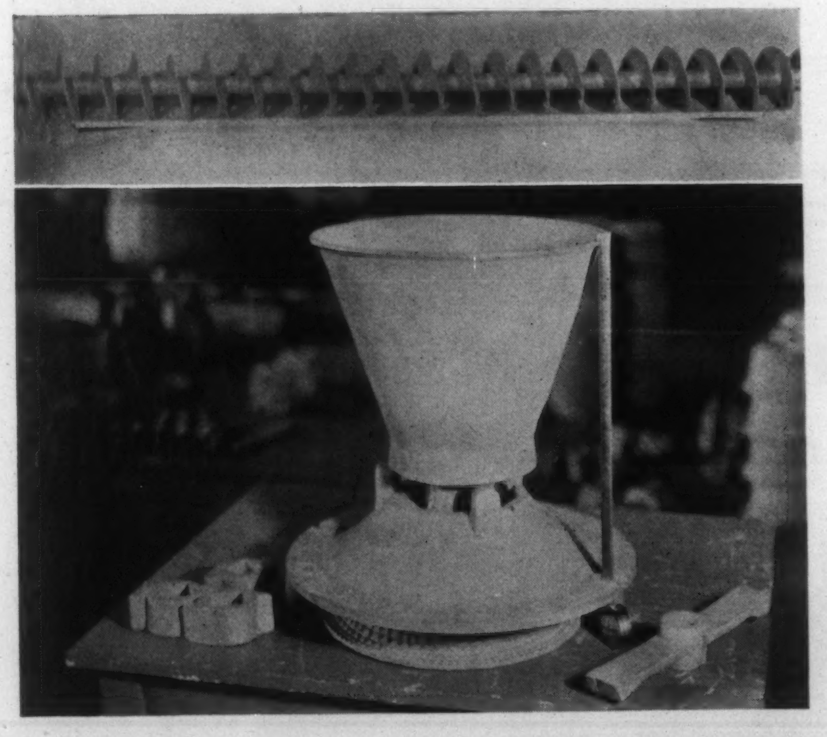

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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

Cylinder Wear Measured from Photomicrographs of the Lubricating Oil. N. A. Everett. *Diesel Power,* Vol. 13, July 1935, pages 454-455. Report on series of tests, at Pennsylvania State College, for observing the behavior of various lubricating oils when used in automobile engines under operating conditions. Photomicrographic examination of the used lubricating oil was found to be suitable for estimating the nature and amount of sand, C, metallic Fe and Fe oxide picked up by the oil during operation. Method is exceptionally suitable for identifying contaminating Al, babbitt, Cu, etc. particles, although present experiments are concerned chiefly with Fe. Photomicrographs are included. FPP (13)

Effective Corrosion Protection by Eloxal Films on Copper-containing Aluminum Alloys (Wirksamer Korrosionsschutz durch Eloxalschichten auf kupferhaltigen Aluminiumlegierungen) Alexander Jenny. *Aluminium,* Vol. 18, Mar. 1936, pages 97-99. In a controversy, the view expressed by R. Sterner-Reiner (*Aluminium,* Vol. 17, July 1935, pages 370-374) that Cu-containing Al alloys cannot be made more resistant against corrosion by the eloxal process is refuted by the author who shows by several examples that by a correct anodic and subsequent treatment a considerable increase in corrosion resistance, particularly against seawater, can be obtained in Cu-containing Al alloys as in all others. Ha (13)

Corrosion Tests (Ensayos de Corrosión) J. Lisbona. *Metalurgia y Construccion Mecanica,* Vol. 2, Apr. 1936, pages 7-8. Methods to determine corrosion resistance of a material, the preparation of specimens, and the evaluation of the test results are briefly described. Ha + FRM (13)

Behavior of Ordinary and of Special Steels in Galvanizing Baths (Sul comportamento degli acciai comuni e speciali nei bagni di zincatura) I. Musatti & A. LaFalce. *La Metallurgia Italiana,* Vol. 28, Jan. 1936, pages 1-17. The corrosion of various types of steel by molten Zn at temperatures of 460°-520° C. has been measured. Corrosion is little affected by addition of C up to 0.2-0.3%, but increases rapidly with higher C, becoming very strong for 0.5% or more C. Si affects corrosion more markedly, 0.2% increasing corrosion 3 times, and 0.87% Si increases corrosion 25-30 times that of Si-free steel. Mn, in amounts normally present, 0.03-0.3%, has practically no influence. Cr has very little influence, 0.56% causing an increase of about 50% in corrosion over a similar Cr-free steel. Ni (about 5%) improves the resistance so as to practically counterbalance the effect of Cr. The resistance of stainless steel and Cr-Ni steel (18-8) to corrosion is about equal to that of low C steel. S, up to 0.080%, and P, up to 0.055% do not affect corrosion appreciably. Increased temperature increases corrosion in all cases, temperatures of 480° C. or more causing a marked increase; the corrosion of 18-8 steel at 520° C. is 3 times that at 460° C. AWC (13)

Modern Theories of Corrosion. Part I. Water Line Corrosion. J. E. O. Mayne. *Journal of the Chemical Society,* Mar. 1936, pages 366-368. Although the distribution of corrosion on steel plates immersed in N/10 KCl has been investigated by Evans and others, and explained by the electro-chemical theory, no satisfactory solution has been given on water line corrosion. The author, by means of suitable laboratory experiments, suggests that water line corrosion is due to the potential existing at the surface of the solution. It was found that corrosion is depressed by the presence of C_2H_5OH in the corroding solution. Technically, corrosion is due to the negative adsorption of the solute at the surface of the solvent. AAA (13)

Excessive Ring Wear. Elton Sterrett. *Diesel Power,* Vol. 14, Apr. 1936, pages 223-225. A case of one sided ring wear, causing noisy engine operation during starting-up periods, is described. Condition was attributed to uneven, heavy C deposit which was thereafter obviated by removing 2" of metal, thus allowing oil-laden air to enter the upper space in two eddying streams instead of one concentrated jet. FPP (13)

Effect of Alloying Elements on the Oxidation of Iron (Einfluss von Legierungszusatzen auf das Zundern des Eisens) E. Scheil & K. Kiwit. *Archiv für das Eisenhüttenwesen,* Vol. 9, Feb. 1936, pages 405-416. The effect of alloying elements on oxidation of various alloy steels at 900°, 1000°, 1100° and 1200° C. was studied. During oxidation distinct oxide layers are formed. The elements more noble than Fe as well as those less noble tend to concentrate between the Fe and oxide layer. Al, Cr, and Si which decidedly raise the resistance to oxidation and Ti, Be, and V which have a smaller effect all tend to form protective oxide layers. The contents of S, B, Mo, W, P, As, and Sb were raised between the Fe and oxide layer; Mn was an exception in this. The addition of more noble metals to steel such as Cu, Ni, and Pt, did not increase the oxidation resistance. Pt indeed decreased it. In the system Fe-Cr-Ni, no alloys resistant to oxidation at 1000° C. similar to the corrosion resistant alloys were found. The conclusion was reached that oxidation entails a movement of the Fe atoms rather than of O_2. To attain protection from oxidation, the material should have a low rate of diffusion and low solubility in FeO, or else form a protective layer about Fe to prevent it from diffusing. SE (13)

Determining Solubility of Steels in Acids (Bestimmung der Säurelöslichkeit von Stählen) R. Walzel & F. Neuwirth. *Archiv für das Eisenhüttenwesen,* Vol. 9, Mar. 1936, pages 451-457. The effect of specimen form, composition of solvent, time, presence of reducing agents, saturation, etc., on the rate of solution of various steels in cold or moderately warm acids was determined. The results were not reproducible. Better reproducibility was obtained with boiling acids. No relationship was found between the natural corrodibility of steels and their rate of solution in acids. SE (13)

Taking Up Wear on Bridge Pins. *Railway Engineering & Maintenance,* Vol. 32, Apr. 1936, pages 235-236. Novel method of eliminating play in pin holes, with means of providing adjustment on both tension and compression devices is described. Method has been successfully applied on a through truss bridge over the Clinch River. FPP (13)

14. APPLICATION OF METALS AND ALLOYS

Nickel and Its Alloys in Petroleum Refining (Das Nickel und seine Legierungen in der Petroleum raffinerie) R. W. Müller. *Werkstoffe & Korrosion,* Vol. 11, Mar. 25, 1936, pages 9-13. The necessity for using high-grade materials in refining industries is explained and the use of Monel metal, Cu-Ni alloys with less than 50% Ni, Inconel (Cr-Ni alloy with about 14% Cr), Ni plated steel, alloy steel with low Ni content and cast Ni steel, and gray Fe with Ni additions (Ni-resist) is reviewed with description of the different parts and fields in operating processes where the materials are best suited. Some operating results are given, and mechanical properties of the materials considered. Ha (14)

Metallurgy in Aircraft Engine Construction. R. C. Moore. *Canadian Chemistry & Metallurgy,* Vol. 20, Mar. 1936, pages 81-82. Higher compression ratios, higher engine speeds and the use of high-grade tetraethyl gasoline have all contributed to increased h.p. The weight/h.p. ratio has been reduced to 1.33/h.p. The composition of the average radial aircraft engine today is approx. 50% steel and 50% Al and Mg alloys with a small percentage of bronze. Selection of steel for various parts and the control testing are briefly touched upon. The magnetic method of examination is one of the most valuable yet applied to aircraft engine parts. WHB (14)

14a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Studies on Bearings with a New Type of High Pressure Lubrication (Untersuchungen an Gleitlagern mit einer neuartigen Schmierung bei sehr hohen Drucken) G. Welter & W. Brasch. *Metallwirtschaft,* Vol. 15, Mar. 6, 1936, pages 227-229. Experiments show that when bearings are lubricated under a pressure of 100-200 atmospheres the starting and running frictions are both greatly reduced, making possible the use of new Al and Zn bearing alloys which do not contain Sn. GD (14a)

Stress Calculations for Thin Aluminum Alloy Sections. S. A. Kilpatrick & O. J. Schaefer. *Product Engineering,* Vol. 7, Apr. 1936, pages 129-133. A method of calculating stresses in thin Al parts, particularly in aircrafts, is explained, taking into account the peculiarities of the material and special sections and fabricated structures used in aircraft. Ha (14a)

Use of Aluminum in the Alcohol Industry (Verwendung von Aluminium in der Spiritusindustrie) Lühder. *Aluminium,* Vol. 3, Feb. 1936, pages 62-63. Al apparatus has been used successfully in alcohol distillation where bronze had failed. Ha (14a)

Treatment of Water Supplies. Hermann Bach. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Sept. 14, 1934, page 184. See "Magnesium Metal for Treating Water," *Metals & Alloys,* Vol. 5, July 1934, page MA 369. MS (14a)

New Steel Sheet House in the Low-Cost Field. *Iron Age,* Vol. 136, Dec. 26, 1935, pages 17D-17E. Describes sheet steel house manufactured by National House, Inc. Structure is assembled from standardized parts of cold rolled Cu bearing black sheets. Outside wall panels are made of No. 14 gage black sheets of standard width of 2 and 4 ft., and 9 ft. high. Interior of walls are steel, sprayed with 2 coats of rust proof paint. They are made with 4, 5 or 6 rooms, and range in price from $3,000 to $6,000. VSP (14a)

Deformation, Heat Treatment, Solubility (Verformung, Wärmebehandlung, Löslichkeit) First Report of the Committee of Non-ferrous Metals. *Korrosion & Metallschutz,* Vol. 12, Jan.-Feb. 1936, pages 2-28. The very exhaustive investigation deals with non-ferrous metals only. Their solubility is determined by their constitution and the manner of pretreatment. The solubility of cold-worked, monophasic Cu-Zn and Cu-Ni alloys follows the solubility law of Heyn. Various kinds of heat treatment and degrees of deformation had no effect on the solubility. The non-ferrous metals do not show any pronounced change of solubility in the whole range of cold working (up to close to ultimate strength). Electric conductivity and electrochemical potential of solution can be used to judge the solubility of monophasic Cu-Zn alloys. Tables show the test results and comparative results with Fe and steel, curves, micrographs are given. 118 references. Ha (14a)

Aluminum in the Shop Equipment Industries. *Machinery,* N. Y., Vol. 42, Feb. 1936, pages 389-391. Present uses of Al in machine tools (housings, supports, portable tools), in paints and possible further extension of the uses are reviewed. Ha (14a)

Bronzes for Chemical Plant. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Oct. 12, 1934, page 262. From *Nickel Bulletin.* Addition of 0.5-2% Ni to bronzes improves mechanical properties, refines grain, increases soundness of castings, and prevents segregation of Pb in Pb bronzes. Examples of its use in castings are heat exchangers, tube plates for condensers for chemical work, and pressure vessels. MS (14a)

Nickel Plated Steel Sheets in the Manufacture of Soap (Nickelplattierte Stahlbleche für die Seifenherstellung) *Nickel Berichte,* Vol. 6, Mar. 1936, pages 37-39. Fe boilers used in soap industry exhibited severe corrosion defects at the interface air/liquid and their life could be materially extended by employing Ni-clad steel for the upper half of the boiler. The ratio of the corrosion resistance in 30-50% NaOH at 82° C. of Ni: Monel metal: steel: cast Fe = 400 : 200 : 11 : 5.5. Besides boilers and tubes structural members of the roof have been made of Ni-plated steel. It is stated that the corrosion products of Fe lead to discoloration and impair the odor of soap. The utilization of Monel metal, Ni and Ni-plated steel for various members of equipment used in soap manufacture is discussed. EF (14a)

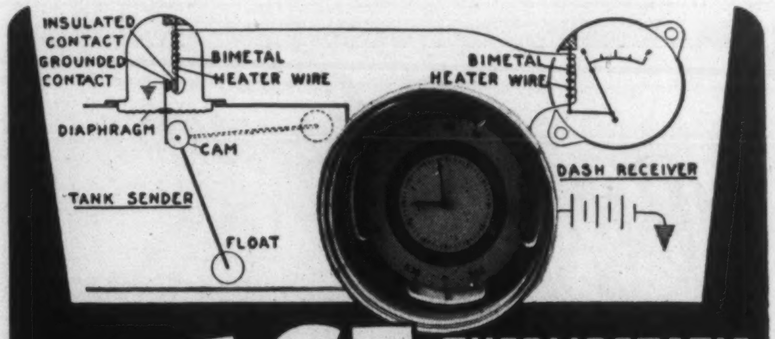
Non-ferrous Alloys Available for the Use of Industry. *Aluminium & Non-Ferrous Review,* Vol. 1, Jan. 1936, pages 135-138; Feb. 1936, pages 198-201; Mar. 1936, pages 241-242. Details of characteristics and uses of proprietary Al alloys produced by Northern Aluminium Co., British and Dominions Ferraloy Ltd., Aluminium Union Ltd., and Birmingham Aluminium Casting Co. Ltd. and of the Manganese Bronze and Brass Co.'s high tensile bronzes and brasses. JCC (14a)

Aluminum for Conduits for Beverages (Aluminium für Getränkeleitungen) *Aluminium,* Vol. 18, Feb. 1936, page 54. The German Labor Department has permitted Al pipes and conduits in addition to Sn and glass for all kinds of beverages, especially for beer. Ha (14a)

New Industrial Uses for Silver. Lawrence Addicks. *Mining & Metallurgical Society of America Bulletin* No. 236, Vol. 29, Jan. 1936, pages 5-21. Use of Ag for bactericidal purposes is discussed at length. Ag as a corrosion-resisting metal, Ag in alloys, and Ag commutators are described briefly. AHE (14a)

Bearing Metals for Internal Combustion Engines. II. H. N. Bassett. *Gas & Oil Power,* Vol. 30, Jan. 1935, pages 20-21. Impurities exert a powerful effect on the structure and physical properties of bearing metal alloys for internal combustion engines. Pb, the most common impurity, decreases ductility, increases susceptibility to high temperature fracture under load, and in certain combinations with Cu and Sb, may develop "wiping" of the Pb-Sn eutectic at high rubbing speeds and high shock loads between 250° and 400° F. Ni, an unusual impurity, reduces the hardness and lowers resistance to crushing. Zn at low temperatures is without effect but raises the yield point considerably at 100° C. Al is very dangerous because of the pronounced liquation induced by its presence, and the replacement of cubic crystals with undesirable globular structure. Bi lowers compressive flow-point at temperatures above atmospheric. Bronzes also are used for internal combustion engine bearings, a wide variety of compositions being available. Methods of casting are described, and the entirely beneficial effect of P, both as deoxidizer and alloying element, is discussed. FPP (14a)

Magnesium in Aeronautic Constructions (Le Magnésium dans les Constructions aéronautiques) R. de Fleury. *Usine,* Vol. 45, Feb. 27, 1936, page 29; Mar. 5, 1936, pages 34-35. Under this title, a comprehensive review of properties, manufacture and use of Al-Cu-Mg, Mg-Cu-Si, Mg-Mn alloys, of methods of studying complex alloys, melting practices, kind of molding sands used for castings, forgings of Mg and fatigue resistance is made. The fatigue resistance of pure Mg is given as 7 kg./mm.², for alloys with 3-15% Al 11-12 kg./mm.², alloys with 3% Cu and 3-12% Al 10-13 kg./mm.² Applications, especially in landing gears, are described. Ha (14a)



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14b. Ferrous

M. GENSAMER, SECTION EDITOR

Accuracy Demanded in Motor Vehicle Rims. Fred B. Jacobs. *Iron Age,* Vol. 137, Apr. 9, 1936, pages 38-42. Illustrates and describes some of the principal operations in production of heavy duty rims at the plant of Firestone Steel Products Co., Akron. Standards formulated by Tire and Rim Association are followed closely for dimensions and tolerances. Rolls used for rolling rims are made of alloy steels.
VSP (14b)

Progress Report on Investigation of Detachable Rock-drill Bits. McHenry Mosier. *United States Bureau of Mines, Information Circular* No. 6877, Feb. 1936, 9 pages. A discussion of the factors that affect the cost of drilling.
AHE (14b)

Experiences on High Pressure Boiler Plates (Erfahrungen mit Hochdruckdampfanlagen) Otto Schöne. *Die Wärme,* Vol. 58, Nov. 23, 1935, pages 765-774. Part of the paper is devoted to experiences on the use of high temperature service steels above 400° C. and on the weldability of these steels. Diagrams show the hardness distribution around a weld of a Cr-Ni-Mo steel joined by 2 different welding methods.
EF (14b)

Wire Ropes and Pulley Stress. Richard Saxton. *Mechanical Handling,* Vol. 23, Feb. 1936, pages 35-36. Excessive wear of strand ropes can usually be traced to unsuitable grooves in the pulley face, leading to crushing, or the choice of too small a pulley diameter. The section of rope making contact with the pulley when the load is first applied is particularly susceptible to damage by overloading, and should be cut out at frequent intervals. Recommended pulley diameters for various sizes of ropes are tabulated.
JCC (14b)

Better Bridges Require Less Maintenance. C. E. Webb. *Railway Engineering & Maintenance,* Vol. 32, Jan. 1936, pages 27-28. The advances in steel bridge practices resulting from better materials, improved methods and modern equipment are reviewed. Refinements in detailing have resulted in longer life and lower maintenance costs. Welding has as yet made small progress in the construction of new R.R. bridges but is proving useful in the repair and strengthening of old structures. Experience shows that bridge replacements are required usually because of inadequate details rather than of overstress in the main members.
FPP (14b)

Stainless Steel Rope for Rigging. R. L. Hopkins. *Marine News,* Vol. 22, Jan. 1936, pages 20-21. Stainless steel does not affect compass readings, being non-magnetic. Other advantages cited; construction of rope strands discussed; reduced diameter due to use of higher strength steel results in less wind resistance.
WB (14b)

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Seamless Tubes for Steam (Les Tubes sans Soudure pour Tuyauteries de Vapeur) Laurent. *Science et Industrie, Métaux et Machines,* Vol. 19, Dec. 1935, pages 444-446. Deals with selection of steel and process of tube manufacture (Mannesmann and Stiefel processes). Sizes of tubes are also discussed.
FR (14b)

A Review of Structural Steelwork Developments. C. J. Kavanagh. *Iron & Coal Trades Review,* Vol. 132, Jan. 17, 1936, pages 127-128. The growing importance of welding and high-tensile steels in constructional work is discussed; some recent British applications are briefly described.
Ha (14b)

Consumer Goods—An Expanding Market for Iron and Steel. Neil E. MacMillan. *Iron Age,* Vol. 137, Jan. 2, 1936, pages 78-79. Considers such domestic equipment as electric refrigerators, washing machines, stoves, radios, vacuum cleaners, toys and play ground equipment, oil burners and stokers and radiators.
VSP (14b)

Stainless-Steel Venturi-Flume Meters. *Engineering,* Vol. 141, Mar. 6, 1936, pages 259-260. Believed to be the first time that non-corrodible steel has been used for facing the whole surface of a venturi-flume meter. Steel used was "staybrite" in descaled condition. Apart from durability due to immunity from corrosion, the steel lining will preserve the original contour of metering throat.
VSP (14b)

Bonded Metals. *Engineer,* Vol. 161, Feb. 28, 1936, page 230. A brief notice about a process developed by Spear and Jackson, Limited, of Sheffield by which any 2 metals with melting points above 1200° C. can be bonded together. After bonding the 2 metals can be worked and heat treated together. No particulars are given of the bonding process. It can be used for facing cutters with high-speed steel or for plating mild steel with a thin layer of stainless steel.
LFM (14b)

Nickel-Clad Steel. *Nickel Bulletin,* Vol. 9, Feb. 1936, pages 25-28. Ni is hot-rolled onto the steel slabs, procedure is briefly described. The material is used for tanks, containers of caustic alkalies, water storage, e.g. hot water storage in laundries, and for the sulphonating equipment in the leather industry.
Ha (14b)

Steels Used for Die-casting Dies. *Machinery,* N. Y., Vol. 42, Feb. 1936, pages 369-371. The particular requirements of steels for this purpose are machineability, stability in heat treatment, resistance to heat checking and to deformation, to cleavage cracking on sudden heating or cooling (toughness), to the erosive actions of molten metal, cleanliness and uniformity. A list of 8 types of alloy steels is given with their chemical composition, and the Brinell hardness which they must possess for use as materials for die-casting of Sn, Pb, Zn, Mg, Al and Cu.
Ha (14b)

Special Steels in American Bridges. *Engineer,* Vol. 161, Mar. 6, 1936, page 255. In recent years there has been a decided trend toward a higher Mn and lower Si content. Ni steel with about 3.25% Ni has been used in a number of bridges. In the Golden Gate bridge there appears a decrease in C from 0.345-0.27%; a decrease in Si from 0.27-0.25%, and an increase in Mn from 0.77-1.25%. Series of studies of alloy steels for bridges with Cu, Cr, Mn, Ni, Mo, Si and V, may result in changes in design.
VSP (14b)

The Selection of Mould Steel. J. C. Alexander. *Machinery,* London, Vol. 47, Jan. 16, 1936, pages 469-470. Brief, general discussion of high C-high Cr, low W and Cr, Mn-Cr, Ni-Cr, C-tool, stainless and mild and soft iron for molds. Characteristics desired are easy machineability, freedom from distortion during thermal treatment, low hardening temperature, intense surface hardness and internal toughness, capacity to take and retain mirror polish, abrasion resistance, nonadherence to molded product, capacity to respond to rapid thermal treatment and stainlessness.
WB (14b)

Stainless Steel in Locomotive Engineering. *Railway Gazette,* Vol. 64, Mar. 20, 1936, pages 567-568. Two types of stainless steels used in R.R. locomotive and car construction are classified as (1) martensitic, 13% Cr and .30% C and (2) austenitic, usually 18 Cr, 8 Ni. Martensitic stainless steels are used for valves or seatings of boiler fittings and other parts subjected to erosion. Precautions against seizing, galvanic corrosion and loss of ductility are cited. Austenitic steel is used largely in passenger cars for ornamental purposes, in kitchen and lavatory fixtures, and in a few notable cases for the entire body of articulated trains. Machining aids are listed.
FPP (14b)

Novel Concrete Pumps (Neuartige Betonpumpen) *Nickel Berichte,* Vol. 6, Apr. 1936, pages 59-60. Stresses the difficulties encountered in the recent design of concrete pumps. Centrifugally cast Fe alloyed with Ni, Cr and Mo and hardened to 500 Brinell was employed to combat wear of the cylinders. The pistons consisted of cast Fe with 3.2% C, 1.75% Si, 0.7% Mn and 2.5% Ni. The hardness is 350 Brinell. A drawing shows the various materials utilized in the construction of the concrete pump.
EF (14b)

Automatic Valves (Selbstgesteuerte Ventile) *Nickel Berichte,* Vol. 6, Feb. 1936, pages 23-24. The main feature of this valve is that it is operated by the expansion of 2 steel rods (27% Ni, 5% Mo) inside a Ni-Cr heater coil. EF (14b)

Steels for Marine Purposes. *Journal of Commerce, Shipbuilding & Engineering Edition,* Jan. 9, 1936, pages 1, 3. A review of recent steel developments of interest to the marine industry deals with the corrosion resisting steels containing Cu and Mo; the stainless, heat-resisting steels containing 25% Cr, 20% Ni; the nitriding of stainless steels; the centrifugal casting of stainless steel; the use of Ni-Cr-Mn steels for pressure vessels; Ni wrought Fe; and a low C, Ni-Mn steel of great mechanical strength and high elastic limit. Consideration is also given to steel treatments and processes including hard-facing processes, metallizing, and bright annealing.
JWD (14b)

Steel Hatch Covers. *Journal of Commerce, Shipbuilding & Engineering Edition,* Mar. 26, 1936, page 1. The use of all steel hatch covers in preference to wooden hatches secured by flat-Fe bars or lashed with steel-wire rope is considered and discussed.
JWD (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Current Activities of the Metallurgical Division of the U. S. Bureau of Mines. R. S. DEAN. *Mining Congress Journal*, Vol. 22, Apr. 1936, pages 20, 37. The following are among the problems studied at present at the U. S. Bureau of Mines: Production of carbon-free ferro chrome; electrolytic production of Mn; explosive shattering of minerals, at pressures up to 4000 lbs.; the use of flotation and high-frequency jigs in the treatment of Au and Ag ores; treatment of high grade Pb concentrates to convert the galena into metallic Pb; recovery of S from smelter gases; the effect of the CaO-MgO ratio in blast furnace slags in the desulphurization of the Fe. BHS (15)

Present State of the Electro Metallurgical Industries, with Particular Attention to Norwegian Conditions (En Oversigt Elektrometallurgiens Nuvaerende Stilling, Med Spesielt Henblikk paa Norske Forhold) ANTON GRÖNNINGSAETER. *Teknisk Ukeblad*, Vol. 83, Mar. 5, 1936, pages 108-114. Address before Norwegian Engineering Societies on Feb. 21, 1936. Discusses the various electrometallurgical processes, from the refining of precious metals to the electric production of Fe, steel, and ferro alloys. Of particular interest to Norway are the electrolytic refining of Ni, with about 10% of the world production refined at Kristiansand, and the electrolytic Zn process, the Eitrheim plant having an annual output of 45,000 metric tons of this metal. Al is produced in Norway at a rate of about 30,000 tons annually. Important industries are also the production of ferro alloys, particularly ferro silicon and ferro manganese. Elastic pig iron is made at two plants. The Norwegian Hole furnace has lately been introduced in Italy, where 5 furnaces are now in operation, and an installation will soon be completed at Domnarivet, Sweden. Production of alloy steel in induction furnaces is also making good progress. The development of the Soderberg electrode, possibly the most important achievement in electric smelting during the last decade, has made possible the construction of the large carbide and ferro alloy furnaces now in use, and it has also led to very important improvements in the Al industry. BHS (15)

Electrical Developments in the Steel Industry. H. A. WINNE. *Blast Furnace & Steel Plant*, Vol. 24, Jan. 1936, pages 71-73, 90. Condensed as **Electric Furnace Developments** in *Heat Treating & Forging*, Vol. 22, Jan. 1936, pages 44-45. Developments and installations by General Electric Co. of rolling-mill drives; ventilation and cooling of mill motor room; gear motors as drag generators; d.c. contactors; factory-assembled control structure; bright-annealing, heat treating, and brazing furnaces; atmosphere control equipment; Calrod heating elements; electric welding equipment; and resistance welder control. MS (15)

Distribution of Useful Metals in the Earth's Crust (Die Verteilung der nutzbaren Metalle in der Erdrinde) I. NODDACK & W. NODDACK. *Angewandte Chemie*, Vol. 49, Jan. 4, 1936, pages 1-5. The geochemical conditions of the earth are explained and a table for the frequency of a metal as percentage of the total of all elements is given for the whole periodic system. O and Si are the most abundant. An estimate of the total available supply of metals in the different countries is made for Fe, Ni, Mn, Cr, Cu, Zn, Pb and Sn and figures are given for the amount of these metals in the earth's crust of 1 km. thickness. The most important processes for the working of metals (preparation, reduction, flotation, magnetic separation, etc.) are discussed briefly. Ha (15)

Research as Related to the Iron and Steel Industry. W. H. HATFIELD. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 50, Session 1934-35, pages 69-73. A brief account of the research which is at the present time being carried on in England. A complete coöperation exists between the National Federation of Iron and Steel manufacturers through its Research Council and the National Physical Laboratory and Iron & Steel Institute. A considerable amount of work on coal and coke has been done by the National Coke Research Committee. These are committees on blast furnace, the open-hearth, rolling mill practice, on the heterogeneity of steel ingots, and on corrosion. GTM (15)

Corrigan, McKinney Steel Company (Subsidiary of the Republic Steel Corporation) CHARLES LONGENECKER. *Blast Furnace & Steel Plant*, Vol. 24, Jan. 1936, pages 75-81. Outlines history of company and describes plant at Cleveland, O. Comprises 204 coke-ovens; 4 blast-furnaces; 14 open-hearth furnaces ranging from 113 to 200 tons in capacity; a 40″ and a 32″ 2-high reversing blooming-mill; a 6-stand 21″ and a 6-stand 18″ billet mill; a 4-stand, 2-high 22½″ and a 7-stand, 2-high, 18″ sheet-bar mill; a 10″ merchant mill consisting of 4-14″ roughing stands, 4-12″ stands, 3-10″ intermediate stands, and 4 finishing stands; and a 12″ merchant mill consisting of 14 stands. MS (15)

Position of Kaiser-Wilhelm-Institute for Metal Research with Regard to Science and Economics (Die Stellung des Kaiser-Wilhelm-Instituts für Metallforschung zu Wissenschaft und Wirtschaft) W. KÖSTER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 80, Jan. 4, 1936, pages 45-46. Aim and scope of work of Institute are outlined; it is to be "the scientific conscience of the metal technique and endeavors to be the conscientious adviser and guide in technical-scientific problems." Ha (15)

Glances at Industrial Research. E. R. WEIDLEIN & W. A. HAMOR. Reinhold Publishing Corporation, New York, 1936. Cloth, 5 x 7½ inches, 246 pages. Price $2.75.

Partly a discussion of the history of Mellon Institute and of its method of operation, partly of industrial chemical research in general. An interesting chapter is that on the development of Plaskon and of the modern Toledo scale in which it is used. Some of the chapters have been previously published as separate articles, and are not very closely related, though they all refer to one phase or another of industrial research. Due to collaboration with various writers, the style varies from quite matter of fact to quite flowery. Research directors will be specially interested in Part 4, questions in industrial research management. Executives will find most of it of interest. Among the familiar names of products developed at or worked on at Mellon Institute are Redmanol, Vinylite, Prestone, Simmons beds and Visking casings for hot dogs. The emphasis is on organic chemistry, little of direct metallurgical interest is mentioned, but the metallurgist can well read it for the analogies to his own field. H. W. Gillett (15) -B-

15a. Economic

Available Raw Materials for a Pacific Coast Iron Industry. Report by E. T. HODGE to U. S. Army Engineers. 4 mimeographed volumes. Division Engineer, North-Pacific Division, (523 Pittock Block, Portland), Oregon, 1935. Paper, 8 x 10½ inches, Vol. 1—130 pages, Vol. 2—101 pages, Vol. 3 and 4, appendixes. Price $1.25 per volume, $5.00 per set.

The contents of the various volumes are: Volume I—Summary, Main Report, Economic Setting; Volume II—Market, Scrap, Economic Factors; Volume III—Iron Ore Deposits of the Western States, North Pacific Coast Iron Ore Deposits (Alaska, Yukon and British Columbia), Iron Ores of Mexico, Iron Ores of the Central Americas, Iron Ores of South America, Trans-Pacific Iron Ores; Volume IV—Fuels and Reducing Agents, Fluxes and Refractories, Manganese, Cost of Pig Iron.

This report is aimed at finding something to do with the Bonneville electric power, planned to be available in 1937. The price for power has not been determined, but it is intimated that it will run between $6.60 and $15.00 per H.P.yr. Since the Bonneville power, available near the harbor of Portland, Oregon, is a case of tide water power, analagous to Norwegian conditions, electric smelting of Fe ore is considered a possibility. It is figured that such a plant would have a potential market for 1,000 tons of pig Fe per day. On that scale it is figured that raw materials alone, choosing those most favorably situated as to location and suitability for electric smelting, would cost some $11.67. At 0.4 H.P.yr./ton, the power cost would run between $2.62 and $6.00. No figures are given for taxes, labor, upkeep, interest, and amortization, nor is comment made on what type of electric furnace would be chosen. Available ores and other raw materials are discussed in minute detail. No estimate is given of the investment required in the smelting plant and in the auxiliary fabricating plants that would have to be built before the potential market would become actual. Nor is anything said of the plans for establishing an "authority" for this district to tell its inhabitants when they may wipe their noses.

The report seems to be planned in the hope of attracting capital to make such investment, but many of the factors that would have to be considered are not dealt with at all. It is a geologist's report rather than that of a metallurgist or a business man. It seems to be very complete on the geological factors, though obviously written by a person who is too much interested in Portland to be likely to take a gloomy view of the possibilities. The Portland climate is highly recommended. H. W. Gillett (15a) -B-

Early Ordering a Safeguard of Quality in Steel Castings. R. L. COLLIER. *Steel*, Vol. 98, Mar. 23, 1936, pages 27-28. Hand-to-mouth buying of steel castings often results in a substandard product. Time is essential in making good castings. Users of castings should anticipate as far as they can their requirements in advance of actual need. This will permit assurance that new designs will be as simple as possible; the proper patterns will be made; the steel to be used will be the best suited to the application; and the castings will be the best which advance precautions and good foundry technique can supply. MS (15a)

A Cost Estimate for Aluminum from Alunite. L. C. PAN. *Chemical Industry, China*, Vol. 10, July 1935, pages 1-12. In Chinese. Based on a process of making Al from alunite through alum and calcining it to alumina, the cost of production is estimated at $0.17/lb. and the cost of plant and equipment at $1,700,000. K_2SO_4 will be a by-product. LCP (15a)

Iron and Steel in the British Empire. THOS. T. RUSH. *Iron & Coal Trades Review*, Vol. 132, Jan. 17, 1936, page 125. A detailed report on output and exports of the various countries of the empire and effects of political agreements. Ha (15a)

A Review of Iron-Ore Mining. H. K. SCOTT. *Iron & Coal Trades Review*, Vol. 132, Jan. 17, 1936, pages 122-124, 126. A survey of world deposits is made and methods of working in different countries reviewed. Ha (15a)

Outlook in the Iron and Steel Industry (Aspectos de Siderurgia) C. TAMA. *Metalurgia y Construccion Mecanica*, Vol. 2, Mar. 1936, pages 7-10. The world situation of iron and steel production, progress made in quality, metallurgical questions and recent ore reduction processes are reviewed. Ha (15a)

Continuous Sheet Mills—What They Mean to Costs and Competition. T. H. GERKEN. *Iron Age*, Vol. 137, Jan. 2, 1936, pages 82-85, 88-89. The construction of a number of continuous sheet mills during the past year, will increase total sheet and tin mill black plate in excess of 16,000,000 tons, within the next 6 months. To utilize this capacity and cost of new plants recovered, new markets must be found. Author explains how this may be done. VSP (15a)

Automobile Industry Accounted for One-Quarter of Finished Steel Consumed in 1935. T. H. GERKEN. *Iron Age*, Vol. 137, Jan. 2, 1936, opp. page 52. A chart showing the distribution to the various industries of rolled steel in 1935 according to shipments of companies producing 78.5% of the year's output. Also gives distribution and production of finished steel, 1922-1935. VSP (15a)

Mineral Production of India, 1934. *Iron & Coal Trades Review*, Vol. 132, Jan. 31, 1936, pages 231-232. The report of the Geological Survey of India gives statistics on pig iron production and exports, production, import and exports of Mn, W, Sn, Zn, Ni and chromite. Ha (15a)

Manganese Ore Production in Hunan. *Iron & Coal Trades Review*, Vol. 132, Jan. 24, 1936, page 195. History and development of mining and production in this Chinese province are briefly reviewed; about 80% of the total production of China originates in Hunan. The ore contains from 45 to 55% Mn. Ha (15a)

Centralising the Steel Trade. *Engineer*, Vol. 160, Oct. 11, 1935, page 379. Editorial discussing the problems encountered at a meeting between the British Iron and Steel Federation and the Continental Steel Cartel. Details of the export agreement such as quotas for overseas markets were discussed but no important decisions were reached. The dangers of centralized control of the industry are pointed out. LFM (15a)

Materials for the Electrical Industry. *Electrical Review*, Vol. 118, Jan. 10, 1936, page 61. Review by Metal Information Bureau, Ltd., of 1935 market conditions relative to Cu, Pb, Sn, Zn, Al, and rubber. Includes outlook for 1936. MS (15a)

British Steel Trade Makes Substantial Upward Progress. J. A. Horton. *Steel*, Vol. 98, Jan. 6, 1936, pages 278-279, 285. Reviews conditions in the iron and steel industry during 1935. Gives statistics on average monthly production, imports, and exports for 1913, 1932-Oct. 1935. MS (15a)

Lack of Confidence Still Hampers French Trade. Leon Jaudoin. *Steel*, Vol. 98, Jan. 6, 1936, pages 280-281. Review of conditions in the iron and steel industry during 1935. Gives statistics on average monthly production, imports, and exports for 1913, 1932-Oct. 1935. MS (15a)

Signs of Partial Economic Recovery Appearing in Europe. Vincent Delport. *Steel*, Vol. 98, Jan. 6, 1936, pages 276-277. Brief review of European steel industry in 1935. MS (15a)

Iron Ore Industry in 1935—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 436, Jan. 10, 1936, 3 pages. Statistical. AHE (15a)

The Influence Wielded by Scrap Copper. Benno Elkan. *Mining & Metallurgical Society of America, Bulletin* No. 235, Vol. 28, Nov. 1935, pages 100-101. Economic. AHE (15a)

Quarterly Statistics of Production of Coal, Gold and Petroleum in India: January to March, 1935. L. L. Fermor. *Records Geological Survey India*, Vol. 69, part 2, 1935, page 241. Statistical. AHE (15a)

The Mineral Production of India During 1934. Lewis Leigh Fermor. *Records Geological Survey India*, Vol. 69, part 3, Sept. 1935, pages 245-335. Statistical. AHE (15a)

Quarterly Statistics of Production of Coal, Gold, and Petroleum in India: April to June, 1935. L. L. Fermor. *Records Geological Survey India*, Vol. 69, part 3, Sept. 1935, pages 387-388. Statistical. AHE (15a)

Metal Mining in Utah, 1935—Advance Summary. C. N. Gerry & T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 424, Jan. 17, 1936, 4 pages. Statistical. AHE (15a)

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Germany's Foreign Trade in Iron and Steel in 1935. *Iron & Coal Trades Review*, Vol. 132, Mar. 13, 1936, pages 498-499. Statistics of import and export in the various groups of products are given; an analysis is made and its relations to the British iron industry discussed briefly. Ha (15a)

French Imports and Exports of Iron and Steel in 1935. *Iron & Coal Trades Review*, Vol. 132, Mar. 20, 1936, page 537. Statistics for the different products are given; the reduction in foreign trade is commented on. Ha (15a)

Statistical Compilations on Lead, Copper, Zinc and Tin. *Metallgesellschaft*, No. 11, Feb. 1936, pages 25-30. Statistics on world production and prices from 1928 up to Jan. 1936 inclusive are compiled for these metals. Ha (15a)

Material and Power Economy in Steel Making (Die Stahlerzeugungsverfahren im Lichte der Stoff- und Energiewirtschaft) H. Bansen. *Stahl und Eisen*, Vol. 55, Nov. 14, 1935, pages 1205-1214. Discussion of the economics of the various charges in the blast furnace, bessemer, and open-hearth, and of the energy consumption. SE (15a)

Aluminum as Domestic and Exchange Material, the Recent Development of Its Uses (Aluminium als Heimstoff und Austauschwerkstoff, die neuere Entwicklung seiner Verwendung) Hans Schmitt *Aluminium*, Vol. 18, Jan. 1936, pages 21-28. The importance, from the German national economy point of view, of the widest application of Al in replacing other metals is discussed and a great number of applications in household and industry, methods of manufacturing, protecting, and electroplating are described. Ha (15a)

Steel Activity on Upgrade After Strong Recovery Year. A. J. Hain. *Steel*, Vol. 98, Jan. 6, 1936, pages 255-257. Review of American iron and steel markets in 1935. MS (15a)

Autos Gain as Leading Steel Consumer; Buildings Second. *Steel*, Vol. 98, Jan. 6, 1936, pages 206-208. Tabulates annual consumption ratios of main groups in the United States for 1922-1935 and distribution of various finished steel products in % and in gross tons to consuming groups for 1935. MS (15a)

Emphasis Is Shifting in Race for Alloy Steel Markets. *Steel*, Vol. 98, Jan. 6, 1936, page 209. Tabulates % of distribution of individual alloy steel products to consuming groups in 1935 and annual % of consumption by groups and by products for 1929-1935. MS (15a)

Canadian Output Best Since 1930. *Steel*, Vol. 98, Jan. 6, 1936, pages 317-318. Brief review of iron and steel industry for 1935. Tabulates statistics on production for 1923-1935. MS (15a)

Belgium and Luxemburg Seek to Keep Export Markets. *Steel*, Vol. 98, Jan. 6, 1936, pages 284-285. Review of conditions in the iron and steel industry during 1935. Tabulates statistics on average monthly production, imports, and exports for 1913, 1932-Oct. 1935. MS (15a)

Strong Recovery Features German Steel Industry. *Steel*, Vol. 98, Jan. 6, 1936, pages 282-283. Review of iron and steel industry during 1935. Tabulates statistics on average monthly production, imports, and exports for 1913, 1932-Oct. 1935. MS (15a)

Prosperity Returning to Lake Superior Ore Industry. *Steel*, Vol. 98, Jan. 6, 1936, pages 248-249. Review of industry in 1935. Mines shipped 28,362,368 tons by vessel. Consumption was about 30,500,000 tons. Stocks on hand at lower lake ports and furnaces Jan. 1, 1936, totaled about 31,000,000 tons. MS (15a)

Directory of Trade Names of Alloy and Special Analysis Irons and Steels. *Steel*, Vol. 98, Jan. 6, 1936, pages 41-48. Consists of 2 parts. First is an alphabetical list of American firms, with the trade-names of their products classed under each company according to types of steels. Part 2 is an alphabetical list of the significant words or symbols in trade-names. MS (15a)

Economic Crisis and Production of Common Metals (La crise économique et la production des métaux usuels) Gaston Camus. *Génie Civil*, Vol. 107, Sept. 7, 1935, pages 225-227. A survey of business statistics shows that a world-wide industrial crisis must affect the production of any country, regardless of the natural advantages it might have over its competitors. JDG (15a)

Merchandising and Selling Gray Iron Castings, 1935, Policy Holders Service Bureau, Group Insurance Division, Metropolitan Life Insurance Company, New York City, 1935, 35 pages, mimeographed. This discussion of the way gray iron foundries seek and try to hold business, is interesting and helpful. Other similar reports, available from the Metropolitan Company deal with apprenticeship in foundries, foundry health hazards, obsolete and inactive patterns, and pattern storage. HWG (15a)

Seventeenth Annual Meeting of the American Zinc Institute. *Journal of American Zinc Institute*, Vol. 16, 1935, 113 pages. Contains the reports and addresses presented at the 17th Annual Meeting of the Institute, Apr. 22-23, 1935. Among the important papers are the following: "The European and World Zinc Situation in 1934," by Oliver W. Roskill; "National Resources Board and Its Relation to the Zinc Industry," by C. K. Leith; "Cooperation Between Mining and Smelting Divisions," by C. S. J. Trench; "Economic Developments in the Zinc Industry," containing reports on the Rocky Mountain Region, the Mississippi Valley Region, and the Eastern Region. Several papers were also presented dealing with the Institute's galvanizing program and the work done to spread the use of galvanized sheets with 2 oz. coating. BHS (15a)

Mineral and Chemical Industries and Agriculture in Sardinia (L'Industrie minéral, l'industrie chimique et l'agriculture en Sardaigne) Ch. Berthelot. *Génie Civil*, Vol. 107, July 20, 1935, pages 53-57. See *Metals & Alloys*, Vol. 7, Feb. 1936, page MA 88L/10. JDG (15a)

The Aluminum Industry. E. C. Harder & E. V. N. Kennedy. *Aluminium & the Non-ferrous Review*, Vol. 1, Oct. 1935, pages 10-14. See *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 517R/8. JCC (15a)

Italy Speeds Up Production and Industrial Organization. Guido Vanzetti. *Steel*, Vol. 98, Jan. 6, 1936, pages 283-284. Reviews conditions in the iron and steel industry in 1935. MS (15a)

Central Europe Forges Ahead; Russia Gains Much. Jan Tille. *Steel*, Vol. 98, Jan. 6, 1936, pages 281-282. Review of iron and steel industry in Czecho-Slovakia, Austria, Hungary, Poland, and Russia during 1935. MS (15a)

Present Situation and the Future of the Aluminum Industry of Japan (Die jetzige Stellung und die Zukunft der Aluminium-Industrie Japans) Zentaro Nakanishi. *Aluminium*, Vol. 17, Nov. 1935, pages 610-614. The historical development of the Al industry since its inception in 1907, statistics on production and imports of raw materials and Al ingots and scrap are given and the present situation reviewed. Ha (15a)

Ferrous Industry in Czechoslovakia (La situation de l'industrie sidérurgique en Tchécoslovaquie) Otakar Quadrat. *Revue de Métallurgie*, Vol. 32, Oct. 1935, pages 469-481. After a brief historical outline the mineralogic situation is presented followed by detailed description of the present plants and statistical data. JDG (15a)

Electrochemical and Electrometallurgical Industries in Germany (L'industrie électrochimique et électrométallurgique en Allemagne) Robert Pitaval. *Journal du Four Electrique*, Vol. 44, Oct. 1935, pages 353-354. By constructing very large power generating plants near brown coal deposits Germans were able to overcome the advantages of water power which they lack and have built a large industry depending on cheap electric current. JDG (15a)

Gold in Canada, 1935. A. H. A. Robinson. *Canada Department of Mines, Mines Branch Report* No. 769, 1935, 127 pages. General, chiefly economic. AHE (15a)

Questions of Location and Transportation of the West-European Iron Industries (Standorts- und Verkehrsfragen der west-europäischen Eisenindustrieen) J. W. Reichert. *Zeitschrift Verein deutscher Ingenieure*, Vol. 79, Nov. 30, 1935, page 1434. Questions of competitiveness of the German with British, French, Belgian, Luxemburgian and Italian conditions in the iron industry are discussed. Ha (15a)

The Attractiveness and Importance of Secondary Metals. F. H. Brownell. *Mining & Metallurgical Society of America, Bulletin* No. 235, Vol. 28, Nov. 1935, pages 95-99. Economic. AHE (15a)

The Advance in the Price of Gold and Its Significance to Canada. G. C. Bateman. *Transactions, Canadian Institute of Mining & Metallurgy*, 1935 (in *Canadian Mining & Metallurgical Bulletin* No. 284, Dec.) pages 552-556. AHE (15a)

20th Annual Review of the Silver Market. Handy & Harman, New York, 1935. 55 pages.

Arts and industries in the U. S. and Canada absorbed 23½ million ounces in 1935, 1½ million less than in 1934. The decrease was chiefly in sterling silverware. World production was 206½ million ounces. The history of the 1935 bull market in silver and the pressure of the silver bloc, the effect on China, and the silver panic of December precipitated by the change in attitude of the U. S. Treasury are discussed. It is concluded that none of the purposes the Silver Purchase Act was supposed to accomplish have been attained, outside the subsidy to domestic producers. This class legislation did damage in terms of foreign financial dislocation and loss of good will. The pamphlet closes with the hope that the legislators in Washington will allow the Treasury to administer the silver act in the "public interest" instead of the "silver interests." HWG (15a)

United States Leads in Striking Gain in World Output; Regains Primacy in Per Capita Use. Vincent Delport. *Steel*, Vol. 98, Jan. 6, 1936, page 210-211. Tabulates production of pig-Fe and steel ingots and castings in the different countries of the world, 1913, 1927-1935; exports and imports of the principal countries, 1913, 1932-1935; and per capita production of pig-Fe and steel ingots and castings in the United States, 1880, 1890, 1900, 1910-1935. MS (15a)

Replacement of Base Metals by Glass (Glas als Ersatz für unedle Metalle) *Keramische Rundschau*, Vol. 43, Jan. 10, 1935, pages 17-18. Announces a decree of the German Minister of Economics forbidding the use, for certain listed applications, of Cu, Ni, Sn and their alloys. Recommends substitution of glass or glass-lined units for many cases, especially large chemical equipment and household fixtures. Plated metal products are largely excluded from the decree, as are parts for motor vehicle, aircraft or marine use. FPP (15a)

World Production and World Consumption of the Most Important Metals in 1934 (Weltgewinnung und -verbrauch der wichtigsten Metalle im Jahre 1934) *Glückauf*, Vol. 72, Jan. 11, 1936, pages 42-46. The metal situation in the different industrial countries is discussed and exhaustive tables are given for production and consumption in each country of Pb, Cu, Zn, Sn, Al, Au and Ag; the available deposits are reviewed. Ha (15a)

Forecasting the Growth of the Steel Industry. Elmer C. Bratt. *Iron Age*, Vol. 137, Mar. 19, 1936, pages 48-52. A forecast of the magnitude of the steel industry in 1940. States that building of factories when current demand is sufficiently high to warrant such move is quite reasonable, whereas building according to indication of average growth is visionary and speculative. To forecast adequately some reasonable expectation must be established as to what the continuance of past growth would produce in the future. Includes statistics, equations and graphs. VSP (15a)

Value of Mineral Products of the United States, 1933-1934, by States—Summary. M. B. Clark. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 445, Mar. 13, 1936, 1 page. Statistical. AHE (15a)

Aluminum Industry in 1935—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 444, Feb. 24, 1936, 2 pages. Statistical. AHE (15a)

Magnesium Industry in 1935—Advance Summary. A. E. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 450, May 1, 1936, 2 pages. Statistical. AHE (15a)

The Platinum Industry in 1935. Charles Engelhard. *Aluminium & Non-Ferrous Review*, Vol. 1, Jan. 1936, page 160. Consumption of all platinum metals in 1935 was probably 275,000 oz. Applications briefly reviewed include use of Pt-Ir for construction of a flute for which great purity of tone is claimed. JCC (15a)

Metal Mining in Colorado, 1935—Advance Summary. Chas. W. Henderson & A. J. Martin. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 420, Dec. 31, 1935, 10 pages. Statistical. AHE (15a)

Metal Mining in Wyoming, 1935—Advance Summary. Chas. W. Henderson & A. J. Martin. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 431, Jan. 23, 1936, 1 page. Statistical. AHE (15a)

Silver Mining and Production in the United States in 1935—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 440, Feb. 13, 1936, 5 pages. Statistical. AHE (15a)

Mine Production of Gold in the United States in 1935—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 441, Feb. 14, 1936, 5 pages. Statistical. AHE (15a)

South Africa's Base Metals and Minerals. A. L. Hall. *South African Mining & Engineering Journal*, Vol. 46, part II, Nov. 9, 1935, pages 307-308. From address "Base Metal and Mineral Resources of the Union" before Transvaal Workers' Educational Association. Economic. AHE (15a)

The World's Gold and Silver Output. H. M. Lawrie. *South African Mining & Engineering Journal*, Vol. 46, part II, Nov. 9, 1935, pages 309-310. Extracts from "Mineral Industry." AHE (15a)

New Alloys. T. W. Lippert. *Iron Age*, Vol. 137, Jan. 2, 1936, pages 171-174, 176-178, 180, 182. Begins with a brief historical survey of alloy steels. Impetus furnished by automobile requirements was accentuated by the airplane, which depends largely on strong and dependable alloys. The oil and power industries, shipyards, and railroads, are also imposing severe service conditions on available alloys. The low alloy steels are among the most important in transportation field. Some of the low alloy high-tensile steels are Cor-Ten, Man-Ten, Mayari, Yoloy, Konik and many others. In the non-ferrous field Al-Ni type magnets are in production. Another magnet alloy is the Al-Ni-Co type produced by General Electric Co., which is superior to a Japanese alloy developed by Mishima. In Al field a satisfactory free machining alloy was produced. Another alloy on the market is a mixture of high metallic boride crystals and low-C steel. Other alloys developed are Doler-Brass, Mallory 3, Fernico, etc. VSP (15a)

World Steel Output 20.6 Per Cent Higher in 1935. T. W. Lippert. *Iron Age*, Vol. 137, Jan. 2, 1936, pages 98-101. World production of steel ingots and castings represents 20.6% advance over 1934, while the United States advanced about 30.5%. United States exports are lower than they were a few years ago, since many countries that bought steel in this country are becoming self sufficient. Germany established a larger gain in steel production than any other country. Belgium and Luxemburg were the only ones producing less steel in 1935 than in 1934. World pig Fe production was about the same as steel ingots and castings, 72,368,000 gross tons, or 16.6% advance over 1934. Per capita consumption of steel in United States was 446.4 lb. Germany was next with 317.7 lb., and United Kingdom third with 268.8 lb. Belgium and Luxemburg were fourth with 241.9 lb. France fifth with 193.2 lb., and Russia sixth with 130.4 lb. Gives tables and graphs showing world production of steel ingots, castings and pig Fe for a number of years. VSP (15a)

The Steel Industry in 1935. G. L. Lacher. *Iron Age*, Vol. 137, Jan. 2, 1936, pages 45-47, 50-52. Recovery in the industry accelerated in 1935, although the improvement did not mark the return of prosperity. In terms of ingot capacity, steel production was only 48%. Ingot production in 1935 surpassed 1934 by 33%. Though less than half of country's capacity was engaged, operations were much steadier than in 1934 and 1933. Developments that influenced the course of steel production in 1935 were the decision of U. S. Supreme Court declaring the N.R.A. unconstitutional, which seemed to increase recovery, and introduction of new automobiles in November instead of in January. Higher costs of fuel, pig Fe and semi-finished steel made advance of finished products necessary, but fear was expressed that high prices might discourage industries which were just beginning to supply their deferred needs. Labor disturbances tended to discourage various enterprises. Number of changes in steel prices were made. Largest increase in finishing mill capacity was in continuous mills producing sheet and strip steel. Beer cans were introduced. Imports increased, while exports decreased. VSP (15a)

Zinc Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 427, Jan. 6, 1936, 2 pages. Statistical. AHE (15a)

Blast Furnace Plans and Prospects in the U.S.S.R. B. M. Suslov. *Iron Age*, Vol. 137, Jan. 30, 1936, pages 28-29, 79. According to the second five year plan the Soviet Union is to have an ultra modern and self-sufficient steel industry. Capital required for this plan amounts to 9,340,000,000 roubles. Its distribution is as follows: (1) for completion of construction of metallurgical works begun during the first 5 year plan period, 4,280,000,000 roubles; (2) for construction and repairing of metallurgical works, 3,910,000,000 roubles; (3) for reconstruction and development of Fe ore and Mn ore, 1,150,000,000 roubles. Includes a number of tables. VSP (15a)

Time Studies in Foundry Work. V. Bernard. *Proceedings Institute of British Foundrymen*, Vol. 26, 1932-1933, pages 292-334. See *Metals & Alloys*, Vol. 5, Apr. 1934, page MA 166. CEJ (15a)

FREE SERVICE DEPARTMENT

Wanted:—By a well-known manufacturer of Heat and Acid Resisting Castings Sales Representatives who are acquainted with buyers and operating heads in the Steel, Automobile, Chemical and Oil Industries in the following territories: New York, Boston, Philadelphia, Chicago, Cincinnati, Houston and Birmingham. No objection to one or two more lines. Reply giving references and full information as to qualifications. Address Box MA-2, Care of Metals & Alloys, 330 W. 42nd St., New York, N. Y.

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■ 15b. Historical ■

With Hammer and Torch (Med Hammare och Fackla) Seventh Year Book issued by Sancte örjens Gille, Stockholm, Sweden, 1936. Paper, 6¾ x 9¾ inches, 171 pages.

A historic review dealing with the early days of the Swedish mining and metal industry. Of particular interest is a description of the Swedish crucible steel process, written in 1769. Also discusses the Brandt-Winjbladh method of smelting Cu as used at Riddarhyttan smelter about 1690 and describes the efforts made at that time to improve Cu smelting. Tests, over several years were also made by a German metallurgist to effect the transmutation of Fe into Cu and Cu into Ag. Other articles deal with the smelting of Au-Ag ore imported to Sweden from Sumatra about 1600, and the methods of power production and the equipment used for hoisting and hauling at the Grängesberg iron works about 100 years ago. B. H. Strom (15b) -B-

The First Blast Furnaces in Upper-Hessia and the Origin of Their Founders (Die ersten Hochöfenhütten in Ober-Hessen und die Herkunft ihrer Giesser) FRITZ SAUER. *Giesserei,* Vol. 23, Mar. 13, 1936, pages 137-139. History of metallurgical industry in this district since the 16th century. 24 references. Ha (15b)

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Steel Tempering Superseded. *Edgar Allen News,* Vol. 14, Mar. 1936, pages 815-816. A historical sketch of the discovery in 1870 of the Mushet self-hardening steel, used for tools and dies. Ha (15b)

Seventy-Five Years of the Verein Deutscher Eisenhüttenleute (1860 bis 1935-75 Jahre Verein deutscher Eisenhüttenleute) *Stahl und Eisen,* Vol. 55, Nov. 28, 1935, pages 1253-1450. Anniversary number. Biographical and historical, fully indexed. SE (15b)

Nickel Industry in 1935 (Die Nickelindustrie im Jahre 1935) *Nickel Berichte,* Vol. 6, Jan. 1936, pages 1-5. The utilization of Ni in transportation, chemical industry, rolling mills for ferrous and non-ferrous materials, mining, building, textile, food, electrical industry, agriculture, refrigerating and oil industry is discussed emphasizing progress made in 1935 as reported by R. C. Stanley. EF (15b)

MANUFACTURERS' LITERATURE

Gasifier

A pamphlet devoted to the Stewart gasifier contains the claims that its use reduces fuel costs as much as 75 per cent, produces a true gas of high B.t.u. value and is easier on furnace lining. Illustrated. Chicago Flexible Shaft Co., Chicago, Ill. (789)

Ladle Fluxes

The advantages of using fluxes for aluminum, brass, bronze, copper nickel, iron and special alloys are listed in a leaflet of The Maluminum Co., Indianapolis, Ind. (790)

Blast Cleaning Equipment

A new quick reference catalog of information on the above has a thumb index which provides easy access to specific items. Dust control and modern types of dust collectors, exhaust fans, etc., Pangborn blast machines, blast rooms, blast barrels and blast tables are some of the topics treated in this brochure of the Pangborn Corp., Hagerstown, Md. (791)

Tool Steel

A colorful leaflet devoted to Saratoga oil-hardening, non-shrinking tool steel contains data on analysis, applications and heat treatment. Ludlum Steel Co., Watervliet, N. Y. (792)

Firebrick

The service of Okilo brick covers a wide range of refractory requirements in the second quality field, according to a pamphlet which discusses the high grade raw material with its fineness of grain and plasticity and the process of manufacture which produces durable brick with a clean hard finish. The Pyro Clay Products Co., Oak Hill, O. (793)

Heat Treating Furnaces

The advantages of forced convection heat treating with recirculation are described in a pamphlet devoted to this subject. According to this leaflet heat time is cut tremendously, uniformity within 1 deg. F. can be obtained in the soaking or holding chamber of Morrison engineered continuous furnaces and atmospheres can be controlled within very close limits. The Morrison Engineering Co., Inc., Cleveland, O. (794)

Testing Machines

Bulletin No. 99 gives a description of the development of the Southwark-Heydekampf machine, and an explanation of its principles. This machine has a rotating cylinder wall, load is read as a function of loading cylinder pressure by means of a small auxiliary measuring cylinder to which pressure is carried. Moving of the measuring cylinder ram is resisted by Iso-Elastic springs. Illustrated. Baldwin-Southwark Corp., Philadelphia, Pa. (795)

Heat Treating Furnaces

According to Bulletin No. SC-75 there is a correct type and size SC standard furnace for any heat-treating operation. Several different types are illustrated. Operating data on a few are included. Surface Combustion Corp., Toledo, O. (796)

Truck Body Construction

Through the use of the light, strong alloys of Alcoa Aluminum, bodies have been built which weigh only 35 to 60 per cent as much as they would have if built of heavier structural materials, according to this catalog. A table of recommended alloys for different applications is included. The alloys are available in the form of structural shapes, sheet, plate, rivets, bolts, nuts, castings and forgings. Aluminum Co. of America, Pittsburgh, Pa. (797)

Quenching Machine

In the Greene tank objects are forced apart and kept in motion, solution vigorously sweeps over the objects and cooling is equal on all sides according to a leaflet which contains the statement that a test will demonstrate the better hardening accomplished by this machine. Illustrated. E. G. Greene, Cleveland, O. (798)

Carburizing

A reprint of an article "Continuous Carburizing of Screws with City Gas" by John A. Comstock is being offered by the American Gas Furnace Co., Elizabeth, N. J. (799)

Oil Burners

Catalog No. 360 claims that this company's burners light, handle and control with a degree of facility not found in other burners because of the following features: separate inner tip maintains high air velocity with thorough atomization throughout working range; combination of inner and outer air tips gives control of length and character of flame and permits adjustment and operation with automatic control, etc. W. S. Rockwell Co., New York, N. Y. (800)

Thermometers

Catalog No. 1250 is devoted to thermometers (recording, controlling and indicating) which are modern in all respects, representing the latest developments in the field of temperature measurement, yet old in principle. Illustrations, scales and charts included, as well as a table of contents. Bristol Company, Waterbury, Conn. (801)

Micromax Thermocouple Pyrometers

A new catalog, N-33A, explains the potentiometer method of measurement, the operation of the mechanisms through which this balance method is made available to industry. The new Silver-Anniversary Micromax is described in detail. It keeps ten inches of record always visible, while a bold pointer enables the operator to read temperature at a glance. The complete line of instruments is set forth. Leeds & Northrup Co., Philadelphia, Pa. (802)

Flame-Otrol

This automatic gas shut off which is simple, positive in operation and operates with split second speed, according to the manufacturer, is the subject of an illustrated pamphlet. Wheelco Instruments Co., Chicago, Ill. (803)

Polishing Machines

A portable model and a floor model of these new metallographic machines are described and illustrated in a pamphlet from Eberbach & Son Co., Inc., Ann Arbor, Mich. (804)

Furnaces

Information concerning Hausfeld modern melting equipment for die casting is featured in an illustrated leaflet. These furnaces are made interchangeable for oil or gas fuel. Campbell-Hausfeld Co., Harrison, O. (805)

Research Puts the Diatom to Work

This booklet discusses the history of the diatom from which Celite is made. The four main industrial services of Celite: high temperature insulation, a filter aid, mineral filler and workability agent in concrete are described. Illustrated. Johns-Manville, New York, N. Y. (806)

Sicromo Steel

High temperature data sheets containing full information on this steel have been issued by The Timken Steel & Tube Co., Canton, O. (807)

Coreless Induction Furnace

A colorful leaflet contains an explanation of the principle of operation and advantages to be obtained from the use of the Ajax-Northrup electric furnaces. Ajax Electrothermic Corp., Trenton, N. J. (808)

Spectrometric Equipment

Catalog D-221 is devoted to the above equipment. Basic theory and design are described as well as the various types of instruments. Illustrated. Bausch & Lomb Optical Co., Rochester, N. Y. (809)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. It is claimed that this series represents the best straight cutting oils obtainable, at a price which meets and beats competition. E. F. Houghton & Co., Philadelphia, Pa. (810)

Industrial Furnaces

This catalog describes, illustrates and gives specifications for furnaces suitable for various applications. Mahr Manufacturing Co., Minneapolis, Minn. (811)

Aerocase

Booklet on this subject. Illustrations, curve charts, tables. American Cyanamid and Chemical Corp., New York, N. Y. (812)

Monel Metal and Nickel

Bulletin C-4 is devoted to the use of these metals in the manufacture of pharmaceuticals, fine chemicals and proprietary products. International Nickel Co., Inc., New York, N. Y. (813)

The Jetal Process

Simple immersion in an aqueous bath for about 5 minutes colors all grades of common iron or steel a brilliant and uniform jet black. It is claimed it does not alter dimensions of articles and cannot chip, scale, peel or discolor. Alrose Chemical Co., Providence, R. I. (814)

Potentiometer Controllers

Bulletin No. 202 covers the complete line of potentiometer and resistance thermometer controllers. A number of simplified wiring diagrams showing how an installation looks are included. Foxboro Company, Foxboro, Mass. (815)

MANUFACTURERS' LITERATURE

Refractory Cement

Bulletin No. 317, describes Q-Chrome neutral-base refractory cement which was designed for severe-service duty. Quigley Company, Inc., New York, N. Y. (816)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (817)

Sonittep Products

This booklet discusses heat loss and its control. The advantage of Sonittep insulating cement and its uses are listed. Instructions for its application are included. Graphs. George F. Pettinos, Inc., Philadelphia, Pa. (818)

Dolomite Refractories

This interesting pamphlet presents the case of Clinkered vs. Calcined Dolomite in the basic open-hearth steel furnace. Basic-Dolomite, Inc., Cleveland, O. (819)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (820)

Flex-Arc Rays

Data bulletins containing information on arc welding are published by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. (821)

Armco H.T.-50

An illustrated folder devoted to the above alloy steel contains data on the average physical properties, corrosion resistance and forming and welding qualities. American Rolling Mill Co., Middletown, O. (822)

Alloy Steels

A colorful folder devoted to these steels lists some of the advantages to be obtained by their use. Bliss & Laughlin, Inc., Harvey, Ill. (823)

Wheelabrator Tum-Blast Cleaner

This cleaner, which it is claimed sets the highest standard of efficiency ever attained in an abrasive cleaning machine is a combination of the Tum-Blast Cleaner and the Wheelabrator. Book 111 is devoted to it. American Foundry Equipment Co., Mishawaka, Ind. (824)

Heat Exchanger

Bulletin No. 173 describes the Duriron heat exchanger which is available in the company's corrosion-resisting alloys—Duriron, Durichlor, Durimet, Durco Alloy Steel and Alcumite. Illustrated. Duriron Co., Dayton, O. (825)

Wet Patch

The manufacturer claims that excellent results are obtained when P. B. Sillimanite wet patch is used to patch crucible furnaces, electric furnaces, etc., because of its high refractoriness, negligible shrinkage and stubborn resistance to slag attack. The Chas. Taylor Sons Co., Cincinnati, O. (826)

Electric Welding Products

Catalog No. 101 contains information on welding rods (recommended uses for the different types, physical properties, welding procedure, etc.); miscellaneous apparatus, and Wilson arc welding machines. Air Reduction Sales Co., New York, N. Y. (827)

Inhibitor

Grasselli 3 inhibitor for efficient, economical pickling is the subject of a booklet of The Grasselli Chemical Co., Inc., Cleveland, O. (828)

Hi-Steel

Information concerning chemical composition, physical properties and corrosion resistance of this steel is offered by the Inland Steel Company, Chicago, Ill. (829)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (830)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections Available Forms and Shop Practice, has been published by The Dow Chemical Co., Midland, Mich. (831)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (832)

Optical Pyrometer

The Burrell optical pyrometer, a direct reading instrument originally designed for use with the Barrett fusion furnace and equally useful for other work requiring an optical pyrometer with a temperature range from 1500 to 3000 deg. F., is described and illustrated in a leaflet published by the Burrell Technical Supply Co., Pittsburgh, Pa. (833)

Phosphor Bronze

A leaflet lists the sizes in which the company's twelve-inch stock bushing bars are now offered. The Phosphor-Bronze Smelting Co., Philadelphia, Pa. (834)

Permite Six Foot Cast Bronze Bars

An attractive booklet states that these bars assure a product identical in physical and wear resisting qualities with the finest individual castings. Joseph T. Ryerson and Son, Inc., Chicago, Ill. (835)

Sand Control in the Foundry

A colorful pamphlet lists the major causes of casting defects and inferiorities and states that they may be avoided by the use of the proper sand control equipment. Illustrated. Harry W. Dietert Co., Detroit, Mich.

Published by the same company: "The Core Maker"—a leaflet and "Deformation and Resilience Accessory for Universal Sand Strength Machine"—looseleaf data sheet. (836)

Heat and Corrosion Resistant Alloys Heated By Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (837)

MoTung High Speed Steel

An illustrated booklet devoted to the above, contains information under these divisions: working and treatment, surface protection, high heat temperatures, drawing temperatures, effect of treatment, etc. An index is included. Universal Steel Co., Bridgeville, Pa., and Cyclops Steel Co., Titusville, Pa. (838)

Temperature Control Instruments

Bulletin 33 is devoted to instruments for automatic control of temperatures in industrial furnaces. Illustrated. American Electric Furnace Co., Boston, Mass. (839)

Controlled Grain Anodes

Seymour Nickel Anodes are homogeneous in grain structure, according to this bulletin. The various available shapes are illustrated and some useful data are given. The Seymour Manufacturing Co., Seymour, Conn. (840)

Granite City HS Grades 1 and 2

Information concerning the Granite City manganese high tensile steels can be obtained from the Granite City Steel Co., Granite City, Ill. (841)

Gas Fired Furnace

The manufacturer of the gas fired Lindberg Cyclone furnace for heating at temperatures from 250 deg. F. to 1400 deg. F. claims that the heating rate is remarkably fast, and either open or extremely dense charges are handled with equal facility. The principle of the furnace is described in Bulletin 51. Illustrations. Lindberg Engineering Co., Chicago, Ill. (842)

Air Operated Control Instruments

A colorful pamphlet devoted to the Air-O-Line controllers contains the statement that engineers like it because it insures maximum accuracy; it is easily adapted to any process control requirement as the throttling range and automatic reset dials are easily accessible and can be reached without removing the chart plate and taking the instrument off control; the balanced bellows system insures exact control point setting; and it is rugged. Illustrated. Brown Instrument Co., Philadelphia, Pa. (843)

Braze-Rite Furnace

This furnace, developed principally for brazing sintered carbide cutting tools, provides for localized heat to be applied only to the portion of the tool to be brazed. The sintered carbide blank to be brazed in place is merely laid onto the shank and after the proper heat has been obtained the blank is firmly pressed onto the shank—all controlled under a hydrogen atmosphere. Illustrated. Firth-Sterling Steel Co., McKeesport, Pa. (844)

Radium for Industrial Radiography

This article written by R. A. Gezelius and C. W. Briggs, containing interesting and important information on the subject, is published in handy booklet form. Radon Company, Inc., New York, N. Y. (845)

A. W. 70-90

This bulletin describes the new high-strength "70-90" steel in sheets and plates. An article on the engineering aspect of high-strength sheet steels is included. Alan Wood Steel Co., Conshohocken, Pa. (846)

CURRENT NEWS ITEMS

Ford Installs the Largest Continuous Electric Furnace

The Ford Motor Co. has purchased from the Westinghouse Electric & Mfg. Co., a 325-ft. long, controlled atmosphere continuous roller hearth furnace for bright normalizing automobile body stock in a continuous strand or in strip. The output of this furnace will be 7½ tons per hr., based on 56-in. wide strip. This is the largest continuous electric furnace in the world. The Ford company already has a 227-ft. long furnace of this type, which it purchased from the Westinghouse company and which has been in operation for about a year.

The rating of the furnace is 2335 kw of which 1920 kw is in the first heating chamber and the remaining 415 kw in the reheating chamber following the first cooling chamber. The strip will be heated in the first chamber to approximately 1750 deg. F. and can be cooled to a maximum of 800 deg. F. in the first cooling chamber. The reheating chamber is amply rated to heat the strip from 800 to 1300 deg. F. if desired and the cooling chamber following is capable of cooling the strip down to 250 deg. F. before it is exposed to the air. Accordingly the furnace is being built to provide for considerable variation in the cycle to obtain the maximum ductility and softness which may be accomplished in a relatively short cycle.

Battelle Adds to Its Staff

Battelle Memorial Institute, Columbus, Ohio, announces the appointment of Dimitry Niconoff, J. G. Donaldson and L. H. Berkelhamer to the technical staff. Mr. Niconoff, who was formerly metallurgist for the Phelps-Dodge Corp., has been assigned to the division of process metallurgy. Mr. Donaldson, who comes to Battelle from the Laclede Steel Co., has been assigned to the chemical division and Mr. Berkelhamer, who was formerly a Bureau of Mines Fellow at the University of Washington, to the ceramics division.

Nickel Co. Expands at Huntington

Increasing interest by industry in the non-ferrous alloys as a weapon against rust and other forms of corrosion has made necessary an enlargement of the laboratory facilities at the Huntington, W. Va., plant of The International Nickel Co., Inc., according to Robert C. Stanley, president. He has also announced that new administrative offices would be built and that a new unit would be added to the open-hearth furnaces.

The plant, which produces monel metal, pure nickel and Inconel in commercial shapes, is now operating at approximately the 1929 level, he said; and a 25-ton open-hearth furnace will be built to bring ingot production in balance with the capacity of the rolling mills. A three-story brick administration building is being erected for the executive offices and the chemical and physical laboratories are being enlarged.

The **Mahr Mfg. Co.,** Minneapolis, announces the appointment of Gerald B. Duff, 39 Oxford St., Newark, N. J., as its representative for that territory. It has also appointed the Fuchs Machinery & Supply Co., 1102 Farnam St., Omaha, Neb., as its representative for the territory surrounding Omaha.

The **Lea Mfg. Co.,** Waterbury, Conn., has added a complete line of sawdust to its already extensive line of platers' supplies. It is carrying hardwood, kiln dried sawdust ranging from the finest to the coarsest.

The appointment of **Arno C. Fieldner** as chief of the technologic branch of the United States Bureau of Mines, Department of the Interior, is announced by Dr. John W. Finch, director of the Bureau. Mr. Fieldner succeeds O. P. Hood, who recently retired after a long period of service.

Promotions by Tagliabue Mfg. Co.

The C. J. Tagliabue Mfg. Co., Brooklyn, manufacturers of indicating, recording and controlling instruments, has announced the promotion of A. F. Rucks to the position of general manager. Mr. Rucks has been associated with the Tagliabue company for over 23 yrs., and has had extended experience in practically every phase of the Tagliabue company's industrial instrument business.

The company also announces the appointment of W. C. Bennett as general sales manager in charge of the eastern territories, and E. D. Wacker as general sales manager in charge of the western territories. Both Messrs. Bennett and Wacker will spend a considerable portion of their time in the field.

Carboloy Announces Staff Changes

Carboloy Co., Inc., Detroit, manufacturers of Carboloy cemented carbide tools, dies and wheel dressers, recently announced the following changes in, and additions to, the personnel of the organization:

P. R. Mallory, former chairman of the board, has resigned. He is succeeded by Dr. Zay Jeffries, former president. W. G. Robbins and E. S. Morrison have been elected to the board of directors.

W. G. Robbins, former vice-president and general sales manager, has been elected president. A. MacKenzie, former manager of manufacturing, has been elected vice-president in charge of manufacturing. K. R. Beardslee, former Pittsburgh District sales manager, has been appointed general sales manager of the Carboloy company. J. R. Longwell, former die engineer, has been appointed chief engineer. A. A. Merry, former Cleveland District sales manager, has been appointed special representative in charge of activities with agents licensed to supply Carboloy on their tools, dies and machines.

A. H. Godfrey, former Cleveland representative, has been appointed Cleveland District manager. P. W. Weiser, former Pittsburgh representative, has been appointed district manager of the Pittsburgh District.

Steel Engineers to Hold Convention

Every phase of steel mill operations will be discussed in 35 technical papers to be presented at the 32nd annual meeting of the Association of Iron and Steel Engineers at the Hotel Statler, Detroit, Sept. 22 to 25. Representatives of companies which manufacture sheet and strip steel and of companies which are prominent in the application and use of steel in this form will be given one full day for the presentation of papers on that topic. Inspection trips through the new strip mills of the Great Lakes Steel Corp., and the Ford Motor Co., will supplement the discussions.

M. E. Leeds Honored

M. E. Leeds, president of the Leeds & Northrup Co., Philadelphia, recently received, almost coincidentally, two signal honors: The Institute of Management gave him its Gantt Medal for "distinguished achievement in industrial management as a service to the community" and Polytechnic Institute of Brooklyn made him Doctor of Engineering "in recognition of great service to society."

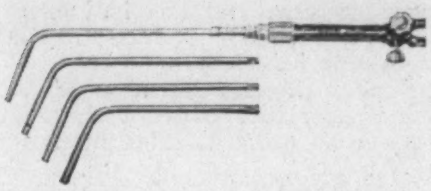
C. Q. Swenson has been appointed Michigan representative by the **Michiana Products Corp.,** Michigan City, Ind., makers of stainless and heat-resistant alloy steel castings. Mr. Swenson is a metallurgist who has had considerable practical experience in the heat-treating industry in the Detroit and Michigan territory for many years. His offices are located at 2842 W. Grand Blvd., Detroit.

R. R. LaPelle has recently become associated with the **Salem Engineering Co.,** Salem, Ohio. He was formerly associated with The Electric Furnace Co., as sales engineer and was more recently section engineer in charge of furnace design for the Westinghouse Electric & Mfg. Co.

NEW EQUIPMENT AND MATERIALS

Light Weight Welding Torch

The Modern Engineering Co., St. Louis, makers of "Meco" oxy-acetylene welding equipment, is in production on its new "Weldmaster" ultra-light weight welding torch. This torch with a standard tip weighs only 17½ oz. and is claimed by the makers to be the lightest weight torch on the market.



A new alloy that can be forged, extruded and heat treated and has a tensile strength of mild steel is used in the construction. According to the makers, the torch is perfectly balanced as a result of weight elimination and can be manipulated by the operator with maximum flexibility and minimum effort.

The circle mixer employed in all Meco torches has been improved and its capacity increased. Even the largest tips may be used efficiently with low gas pressures, as when working from medium acetylene generators. A new method of boring passages to rifle smoothness has been developed in this torch. Ideal flame characteristics under any operating circumstances in the full range of welding practice are claimed. These torches are made in two types, the standard and the super.

Protective Coating Material to Prevent Carburizing

K-Seal, a product of the Lindberg Engineering Co., Chicago, offers important advantages in steel treating operations where it is necessary to limit the carburizing action to certain areas. It is supplied in the form of a powder and a liquid which are mixed in definite proportions as used. When applied to the surface of steel, properly cleaned and free from oil, before the carburizing treatment, this protective coating will entirely prevent the penetration of carbon.

For example, if machining or straightening is to be done on a particular part while in a hardened condition, the application of K-Seal before carburizing will keep the painted section soft at the point where the machining or straightening is to be performed. The material adheres firmly to the steel surface, so that very sharp boundaries can be obtained between the areas of full penetration and the painted areas where there is a total absence of additional carbon.

This useful material is claimed to provide a simple solution to many heat-treating problems and to open up new possibilities in the design and fabrication of machine parts.

Enamel Finish for Die Castings

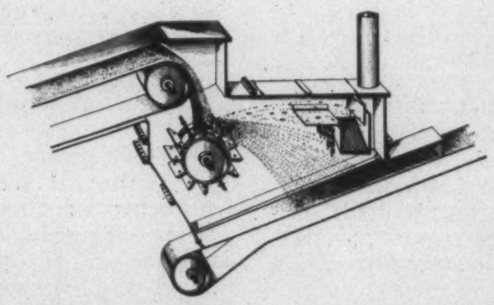
The difficult problem of developing an enamel finish that will adhere tenaciously and continuously to zinc has been successfully solved by Maas & Waldstein Co., makers of lacquers and lacquer enamels, Newark, N. J., according to an announcement by that company. As a result of its research work the company is now placing on the market a new line of air-drying lacquer enamels which are especially designed for finishing zinc and aluminum die castings. These new die-casting lacquer enamels are claimed to produce an excellent, durable, elastic finish in one coat. They are supplied in gloss and egg-shell sheens and in white, black, and 32 standard shades. Special colors can be supplied when desired.

A New Foundry Sand Aerating, Separating Unit

Announcement is made by Link-Belt Co., Philadelphia, Chicago, that it has placed on the market a new foundry sand preparation unit, known as the Link-Belt "Sep-Aerator" because it performs automatically the two-fold function of, (1), properly aerating and mixing the sand before delivery to molder's hoppers, and, (2), separating from the sand, such shot metal, pebbles and small refuse as may not have been caught by screen or magnetic pulley. This separating feature is of particular value in non-ferrous foundries, where it is not possible to remove metallic shot by magnetic attraction.

The "Sep-Aerator" is a high-capacity unit, which is said to be ideally suited for continuous mechanical handling systems, and supplements the Link-Belt line of sand revivifiers. The several installations that have been made have shown that the amount of refuse removed each time that the sand passes through the machine, makes the installation one that assists greatly in the foundryman's desire to produce better castings at lower cost.

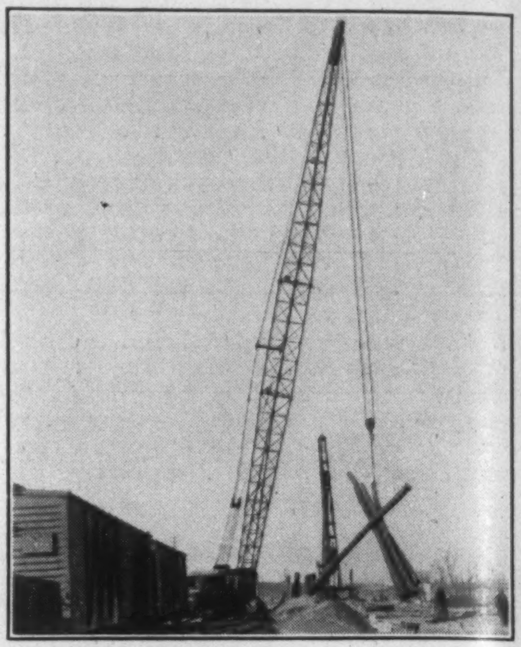
The operating principle is revealed in the illustration, which also shows that the unit is one of few parts—a power-driven paddle-type beater, with sand and refuse collecting and discharging media, all enclosed within a steel housing, which is fitted with an air-release pipe and other suitable means for preventing any blast of air along belt conveyor which receives and carries the aerated sand away from underneath the machine, to the respective molder's storage hoppers.



The position of beater shaft can be adjusted horizontally as required to give proper control of direction of the sand stream. After the beater shaft has been correctly located, the flow regulating plate is adjusted to split the stream of sand and refuse at the desired point. As the refuse travels forward, close to the top of Sep-Aerator housing, it is deflected by a baffle, which permits escape of air currents and assures delivery of refuse to its chute. A shield of chains in front of the refuse chute keeps the sand from building up at this point. A screen bottom in refuse chute permits any sand, traveling with the refuse, being diverted to the aerated-sand conveyor.

A Light, Welded Tube Boom for Cranes

The remarkably long boom of this P&H Model 575 crawler crane was designed by the Harnischfeger Corp., Milwaukee, especially for the extremely high lift required for the erection of catenary towers to carry electric power lines. In contrast with the standard boom of structural steel which weighs 125½ lbs. per ft., this boom, arc welded of tubular steel, weighs only 75½ lbs. per ft. and provides a reach of 100 ft. The lightness of this boom makes it possible for the machine to lift normal loads more than 80 ft. high without undue tipping strains.



New Model Incandescent Lamp Blueprinter

Another model has been added to the line of Angstrom lamp "Blueprinters." This one is double the size of previous models, viz., 24 by 36 in., and has been developed to supply the needs of those whose work could not be handled on the 18 by 24 in. sizes.

Essential features of the older model are all retained, including the use of incandescent lamps as a light source and elimination of the belt feed by the flat bed printing surface.

A timing switch of the heavy duty type has been developed for automatically breaking the heavier current and forced ventilation is supplied to prevent any tendency to overheat. Both of these features are also available on the smaller machine.

The same economy of operation is claimed for the new model with a cost for prints approximating 1.3c per sq. ft. The Blueprinter is manufactured by Milligan & Wright Co., 1231 West Third St., Cleveland.

"Kwik-Cote" Copper Plate Solution

This product was developed originally by Grapho Products, Inc., 2232 Alvord St., Indianapolis, Ind., to lower the cost of plating where selective hardening is necessary. "Kwik-Cote" is a chemical compound which deposits a copper plating on the part to be treated by dipping or painting with a small stiff brush. Hair-line separation of hardness can be secured with positive results.

With Kwik-Cote any portion of the part to be hardened can be treated.

Preparation for hardening takes but a few minutes as the solution dries almost at once and can be placed in the carburizing pots immediately. A scleroscope hardness variation from 80 to 30 is secured. Threads treated with Kwik-Cote may be kept dead soft and in perfect condition while the remainder of the piece is hardened. Only the parts to be kept soft are treated.

It may be used between cams, back of gears, threads, in bores where stock is left for reaming after heat treating, on springs and any section to be kept soft. The solution may be used as a base for nickel or chrome plating. The work is thoroughly cleaned, dipped in the solution, the surplus liquid washed off and is ready for plating.

New Line of Controllers

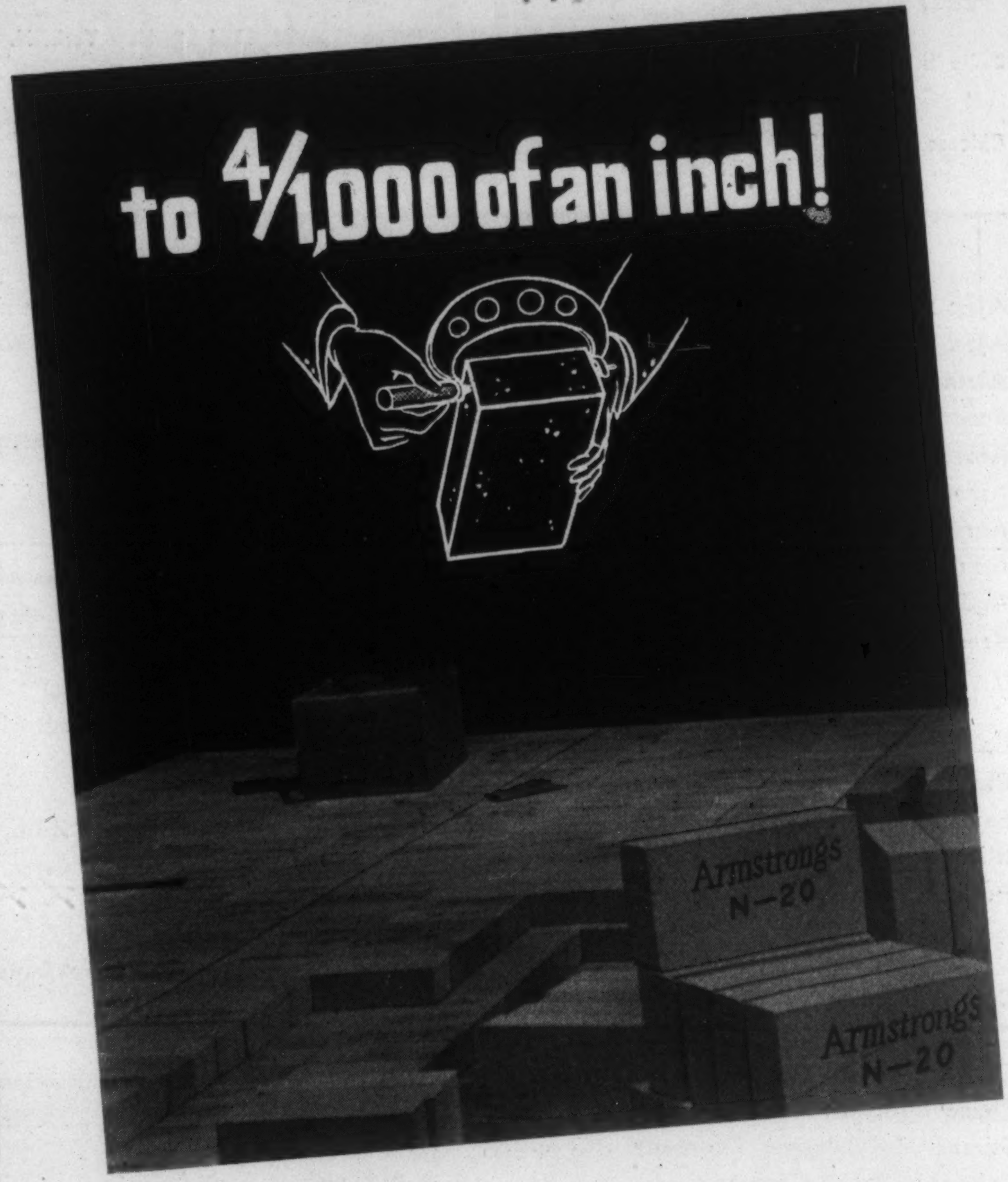
A new line of controllers for temperature, time-temperature, flow, liquid level, pressure, time-pressure, and humidity is announced by The Bristol Co., Waterbury, Conn. These controllers, known as "Master Free-Vane Controllers" are offered primarily for applications where a greatly reduced sensitivity (wide throttling range) is required and the load conditions fluctuate over a wide range.

The Master Free-Vane Controller is a pneumatic-type controller operating on Bristol's free-vane principle of control. It is similar in many respects to the new Ampliset controller, an instrument equipped with a sensitivity adjustment, announced by this company recently.

In the Master Free-Vane Controller the basic free-vane system is equipped with a sensitivity adjustment, an automatic reset, and accessory features which minimize hunting; prevent departure from the control setting; make it possible to reach a new control setting without over-shooting; to adjust the anticipatory effect to fit the process lag; and to adjust the resetting mechanism to function in an amount proportional to the rate of change in the process.

The Master Free-Vane Controller is offered primarily to take care of more severe conditions encountered in processes, such as sudden load changes, over-shooting, etc. It is designed to automatically compensate for each of the disturbing elements in industrial processes that, from time to time, have a tendency to upset the true function of the control system. It also makes it possible to obtain precision control on extremely difficult applications without assistance from the operator. Moreover, it is a self-contained instrument of quite simple design with all parts contained in one case.

ACCURATELY SIZED



That's why Armstrong's Brick insure a *heat-tight* job every time.

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The work shown is the base of a box-type annealing furnace recently completed for a large steel company. The bottom is insulated with two layers of 2½" Armstrong's Insulating Brick, the sidewalls and arch with a single layer of the same efficient brick.

In addition to accurate sizing, Armstrong's Brick offer the further advantages of high crushing strength, low thermal conductivity, and freedom from shrinkage. Armstrong's Insulating Brick and Insulating Fire Brick are available in a full range of service and temperature requirements.

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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

A New Gold Producer in Roumania.—Telluride Ore Dressing at the New Sacaramb-Nagyag Mine (Ein neuer Golderzeuger in Rumänien.—Das Bergwerk von Sacaramb-Nagyag und die Aufbereitung seiner Goldtellurerze) Herbert Sommerlatte. *Metall und Erz,* Vol. 33, Mar. 1936, pages 137-142. Roumanian gold-mining in the past year has been pushed zealously. Waste heaps and gobbing residues, containing enough Au to justify reworking have been mixed with crude ore and reworked in modern flotation plants. The yield of Au varied between 75 and 90%. Complete description of plants, with grades and analyses of ore is given. FPP (1)

Developments in German Iron Ore Mining (Über die Entwicklung des deutschen Eisenerzbergbaues) W. Luyken. *Metall und Erz,* Vol. 33, Jan. 1936, pages 2-11. Historical and statistical review of economic and technological developments in German Fe ore mining since 1913 is presented. Germany's practical self-sufficiency with respect to Fe ore, and the extent to which development of various individual geographical districts has furthered this, is discussed. The most important recent development has been a process for utilizing low-grade ore. FPP (1)

1e. Amalgamation, Cyanidation & Leaching

Utilization of Talitter Copper Shale (Zur Nutzbarmachung des Kupferschiefers von Talitter) H. Wölbling. *Metall und Erz,* Vol. 33, Mar. 1936, pages 143-144. A method is described for working Ca rich Cu shales such as the Talitter deposits, by ammonia-leaching. More than 90% of the Cu content can be extracted quickly and cheaply. The extraction residue may be marketed as lime fertilizer to offset the cost of production. FPP (1e)

Modern Metallurgical Practice on the Witwatersrand. T. K. Prentice. *Bulletin, Institution of Mining & Metallurgy,* No. 367, Apr. 1935, 1935, 44 pages; No. 368, May 1935, pages 1-19; No. 369, June 1935, page 33; No. 370, July 1935, pages 1-2; No. 373, Oct. 1935, page 1; No. 376, Jan. 1936, pages 31-38. On the Witwatersrand there are 38 large reduction plants with an average milling capacity of approximately 87,000 tons/mo. each. The last 6 to be erected did not incorporate either stamps or sand treatment units; capital costs were reduced. In the last 5 years 3 new plants were built. Modern high-speed gyratory crushers prepare the feed for the tube mills in the new plants. In 2, milling is in cyanide solution, in the other, in water. In all, Dorr classifiers of the straight drag of the bowl types are used exclusively for classification. Only 1, with the richest ore, has installed corduroy tables for removal of Au from the tube-mill circuit for amalgamation; the others depend entirely on cyanidation. Each uses the Crowe-Merrill vacuum filter leaf method of Zn-dust precipitation. In the Central Mines-Rand Mines group, 1 ton of —100-mesh product by the crusher-stamp and tube-mill combination cost 20.6d.; by the modern crusher-tube mill combination, 19.9d.; costs of 1 ton of —200-mesh material was 29.7 and 28.3d., respectively, by the 2 methods. Cost of cyaniding in an all-sliming plant was 12.3 d./ton; in plants with a sand and slime treatment, 13.6d. Recovery is 92-98%. Cyanide consumption is 0.16-0.50 lb./ton milled. The various steps are discussed with a historical review of metallurgical developments. AHE (1e)

Notes on Ore Pulp Settlement and Filtration, in Cyanidation of Gold Ores. R. J. Lemmon. *Proceedings Australasian Institute of Mining & Metallurgy* No. 98, June 30, 1935, pages 349-356. The constituents in ore and water that affect settlement, filtration and Au extraction are discussed. Flocculators and precipitants in common use include lime, soda ash, $BaSO_4$, and Na aluminate. For deflocculation, NaCN, Na silicate, caustic soda, etc. are employed, according to the ore pulp constitution. AHE (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

Influence of Various Metals and Metal Oxides on the Decomposition of CO (Der Einfluss verschiedener Metalle und Metalloxyde auf die Kohlenoxydspaltung) W. Baukloh & G. Hieber. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 226, Mar. 17, 1936, pages 321-332. Commercially pure powders of Fe_2O_3, Fe_3O_4, Fe, Co_3O_4, Co, Ni_2O_3, NiO, Ni, Cr_2O_3, Cr, Mn_3O_4, Mn, Al_2O_3, Al, ZnO, Zn, CuO were heated at various temperatures in an electric furnace with dry CO passing over the samples contained in a boat. Curves are given for total increase in weight due to C formation versus time, periodic formation of C versus time and C formation versus temperatures between 350° and 750° C. The indications are that Fe catalyzes the CO decomposition. With Co_3O_4 and Co there is increasing CO decomposition up to 650° C. and at 550° C. where the $\alpha \rightarrow \beta$ transformation occurs there is a dip in the decomposition versus temperature curves indicating the loss of catalytic activity at transformation point. Contradictory results were obtained with Ni and its oxides. Cr gave only slight CO decomposition, Mn_3O_4 none, and Mn considerable. Al gives slight C formation and Al_2O_3 none. In reduction of an ore with CO the solid sample distintegrated due to internal C formation. WB (2)

2a. Non-Ferrous

Electrolytic Refining of a Gold-containing Crude Silver Ore Contaminated with Lead and Selenium, Without Preliminary Treatment (Raffination eines vor allem mit Blei und Selen verunreinigten goldhaltigen Rohsilbers auf electrolytischem Wege ohne vorhergehende Feinbrennung) Gotthard Lenk. *Metall und Erz,* Vol. 33, Apr. 1936, pages 201-207. An extensive discussion of electrolytic refining of crude Ag containing 1 — 6% Au, 1.25 — 2.4% Pb and 1.0 — 1.8% Se, as compared with other methods of treatment. Process flow charts are included. FPP (2a)

Smelting in the Lead Blast Furnace. Handling Zinciferous Charges. G. L. Oldright & Virgil Miller. *Metal Industry,* London, Vol. 46, Jan. 25, 1935, pages 122-124; Feb. 8, 1935, pages 173-175; Apr. 26, 1935, pages 460-463; Aug. 2, 1935, pages 112-114; Aug. 9, 1935, pages 139-141; Aug. 23, 1935, pages 182-184; Aug. 30, 1935, pages 204-208. Condensed versions of *U. S. Bureau of Mines Report of Investigations* 3244, 3245 and 3246. See *Metals & Alloys,* Vol. 7, May 1936, page MA 226L/2. HBG (2a)

Bauxite-Soda Versus Bauxite-Soda-Lime Charge. A. N. Varshavskii. *Legkie Metallui,* Vol. 4, Sept. 1935, pages 46-52. In Russian. Substitution of a bauxite-soda charge at the Volkhov Alumina Plant for the bauxite-soda-lime charge used at present would increase the cost and decrease extraction. HWR (2a)

Production of Aluminum Sulphide. A. I. Belyaev, A. I. Lainer & E. I. Khazanov. *Legkie Metallui,* Vol. 4, Sept. 1935, pages 1-14. In Russian. Bauxite, pyrite, Zn blende, and coke were fused together in an electric arc furnace. The slag obtained contained up to 66% Al_2S_2. HWR (2a)

Current Density During Electrolysis of Magnesium from Carnallite. A. Y. Taitz. *Legkie Metallui,* Vol. 4, Sept. 1935, pages 14-22. In Russian. Varying the current density between 0.5 and 2.0 amp./cm.² does not change the current efficiency. HWR (2a)

The Thermal Diagram for the System:—FeS-Cu_2S. With a Note on the Determination of the Dissociation Pressure of Iron Sulphides. D. D. Howat. *Journal Royal Technical College,* Vol. 3, Jan. 1936, pages 587-598. A thermal diagram which has been constructed from a consideration of both thermal and microscopic evidence is put forward for the system FeS-Cu_2S, and shows limited solubility of both constituents with the formation of a eutectic. Cu_2S is soluble in FeS up to 20% and FeS in Cu_2S up to 40% at 970° C. The eutectic temperature is 970° C. and the composition 61% Fe, 39% Cu_2S. A method is also suggested for the measurement of the dissociation pressures of Fe-sulphide mixtures by means of the reduction of the sulphides with H. JWD (2a)

Electrolytic Zinc Produced from Zinc Fumes Obtained from Lead Furnace Slags at Trail, B. C. (Zinc électrolytique obtenu des fumées de zinc provenant des scories de fours à plomb à Trail (Colombie Britannique)) W. H. Hannay & James Bryden. *Revue de Métallurgie,* Vol. 33, May 1936, pages 314-317. Abstract from Canadian Institute of Mining & Metallurgy, Vol. 37, 1934, page 141. See *Metals & Alloys,* Vol. 5, July 1934, page MA 311. JDG (2a)

Treating Zinc Electrolysis Residues and Lead Furnace Slags in Furnaces in Which Ash Is Fused (Le traitement au gazogène à fusion de cendres des résidus de l'électrolyse du zinc et des scories de fours à plomb) J. Van Oirbeek. *Revue de Métallurgie,* Vol. 33, May 1936, pages 303-308. Abstract of the paper delivered before 7th International Congress of Mining & Metallurgy in Paris. At Viviez plant of the Societe de la Vielle Montagne a plant has been operated for 7 years handling about 190 tons/day of residues. It is a modification of a shaft furnace. Preheated air is introduced through tuyeres. Coke and briquetted residues are charged. Gases are purified in a Cottrell apparatus and in a Thiessen. Their composition approaches blast furnace gas. About 18% are consumed for preheating, the rest is commercially utilized. Cottrell precipitates are dissolved for Zn electrolysis, the matte is sold to Pb refiners. JDG (2a)

Zinc in Germany (Deutsches Zink) H. Grothe. *Chemiker Zeitung,* Vol. 60, Mar. 25, 1936, pages 253-257. German Zn consumption, 200,000 tons annually, is second only to that of the United States, and is divided: 33.5% for rolled and pressed Zn, 26% for Zn alloys, 20% for galvanizing and 20.5% for the preparation of Zn oxide and other pigments. Zn is extracted by reduction of the oxide (distillation process) or by electrolytic deposition from a mineral acid solution of Zn salts. Both methods are described in some detail with flow sheets and discussion of process variations. FPP (2a)

Segregation Method for Lean Oxidized Copper Ores (Le procédé de ségrégation des minerais de cuivre oxydés pauvres) Maurice Rey. *Revue de Métallurgie,* Vol. 33, May 1936, pages 295-302. When Cu ores are reduced with C small particles of the metal remain imbedded in gangue. Addition of small amounts of chlorides before reduction collects metallic Cu on the surface of C particles. The chlorination process is about 10 times as fast as C reduction. Cl acts apparently in a closed cycle; only 1/10 of the amount required to form CuCl is required for extraction. Basicity of the gangue reduces efficiency of the process. NaCl can be replaced with $MgCl_2$, CuCl, $CuCl_2$ or $CaCl_2$; KCl and $BaCl_2$ give much inferior results. At the Alaska Mine of Southern Rhodesia Base Metal Corporation ore containing 5% Cu is roasted on the first 5 hearths of a furnace. About 0.4-0.5% salt and 1.5% coal finely ground are added on the sixth hearth. Segregation takes place on sixth and seventh hearths. The ore is then cooled in a rotary cooler. A months run in the furnace gave concentrate containing 68.2% Cu corresponding to 86.91% recovery. JDG (2a)

2b. Ferrous

Five Years of Progress in Southern Blast-furnace Practice. Francis H. Crockard. *American Institute Mining & Metallurgical Engineers Technical Publication* No. 653, Dec. 1935, 20 pages. Progress has been brought about by improved raw materials, modern furnace design, and careful attention to the Fe after it leaves the furnace. Coke ash has been reduced, resulting in lower cost of operation, closer Si control, and improved porosity. Pulverization of coal has yielded better coke structure. Sizing of both ore and coke has resulted in better operation and higher-quality product. Furnace design has tended to wider stock lines, resulting in less dust loss. Machine-cast Fe is triple skimmed and slowly cooled. Chemical analyses are better because of selected ores. Better practice has reduced coke consumption from 3000 to 2200 lb./ton of Fe in spite of burdens containing only 35% Fe and yielding over 2000 lb. slag/ton of Fe. JLG (2b)

Blast Furnace Improvements Needed. *Steel,* Vol. 98, Jan. 6, 1936, pages 245, 338-339. Reviews blast-furnace developments in 1935, as seen by several authorities. MS (2b)

Production and Preparation of Blast-furnace Flux. P. C. Hodges. *Metals Technology,* Jan. 1936, *American Institute Mining & Metallurgical Engineers Technical Publication* No. 668, 11 pages. Describes rock formation, quarry, and operation of Marble Cliff Quarry at Columbus, Ohio. JLG (2b)

Low-Temperature Reduction of Magnetite Ore. Effect of Catalytic Compounds. G. C. Williams & R. A. Ragatz. *Industrial & Engineering Chemistry,* Vol. 28, Jan. 1936, pages 130-133. Certain Na and K compounds greatly accelerate the rate of reduction of magnetite at 900° C. Hardwood charcoal is a much more active reducing agent than metallurgical coke and responds to the action of Na_2CO_3 as catalyst. The data tabulated in this article show that the catalytic effect of various compounds is a function of their concentration in the reducing mixture as judged by the action of alkali and alkaline earth carbonates. Silica tends to inhibit the action of Na_2CO_3. MEH (2b)

New Developments in Blast Furnace Practice. T. P. Colclough. *Iron & Coal Trades Review,* Vol. 132, May 1, 1936, pages 806-807. Using Northamptonshire ores the burden is designed so as to give the most economic conditions of operation within the furnace regardless of the S content of the pig Fe produced; any excess of S above specifications is removed by subsequent treatment after tapping the Fe from the blast furnace. The actual operation (covered by patent) is described. Ha (2b)

The Desulphurization of Pig Iron by Manganese (Die Entschwefelung des Roheisens durch Mangan) H. Wentrup. *Archiv für das Eisenhüttenwesen,* Vol. 9, May 1936, pages 535-542. The desulphurization of Fe by means of Mn and the effect of C alone and together with Si and P on the reaction was studied. At 1250° to 1350° C. the solubility of S in Fe is appreciably lowered by Mn. Desulphurization of pig Fe in ladle and mixer occurs by the floating up of the Fe S — Mn S complex to the slag. SE (2b)

Note on the Use of Scrap in the Blast Furnace (Beitrag zur Schrottverhüttung im Hochofen) W. Lennings. *Stahl und Eisen,* Vol. 56, Mar. 19, 1936, pages 349-351. Melting scrap in the blast furnace entails a high coke consumption. The heat generated by the coke is small, since it burns only to CO and not to CO_2. Data on coke consumption with varying amounts of scrap and different Fe ores are given. SE (2b)

High Alumina Blast Furnace Slags. A. D. Sokolskii. *Legkie Metallui,* Vol. 4, July, 1935, pages 18-40. In Russian. Slags containing 50-55% Al_2O_3, 40-45% CaO, and 3-4% SiO_2 can be obtained without difficulty in a blast furnace. HWR (2b)

Alumina from Blast Furnace Slags. P. B. Golubkov. *Legkie Metallui,* Vol. 4, July, 1935, pages 13-17. In Russian. Slags containing 50-55% Al_2O_3, 38-45% CaO, and 3.5-5.7% SiO_2 were treated with a solution of Na_2CO_3. At a temperature of 98°, about 80% of the Al_2O_3 was extracted in 5 hrs. The ratio SiO_2: Al_2O_3 in the solution was 0.004. HWR (2b)

Measurements on the Blast Furnace (Messungen am Hochofen) W. Liesegang. *Archiv für Technisches Messen,* Vol. 5, Jan. 1936, pages T5-T7. Measuring methods and instruments, and the correct places where the measurements are to be made are described for the blast heater, gases and waste gases, number and sequence of charge, blast temperature and composition of blast furnace gas. 19 references. Ha (2b)

Effect of Manner of Charging on Gas Currents in the Blast Furnace (Gasströmungen im Hochofen und ihre Beinflussung durch die Art der Begichtung) W. Feldmann & J. Stoecker. *Stahl und Eisen,* Vol. 55, Dec. 26, 1935, pages 1559-1564. Variations in gas flow in the upper part of the blast furnace with ordinary and interrupted charging, and with doubled and halved charge were determined. SE (2b)

Electrostatic Purification of Gases Produced in Smelting Ferromanganese. N. I. Korobov & N. G. Molchanov. *Metallurg,* Vol. 11, Apr. 1936, pages 34-48. In Russian. Experiments were conducted on a blast furnace having daily capacity of 90 tons, using 35% Mn ore and consuming 3 tons of coke/ton of metal. During operation 17% of the charge was carried away as dust. Detailed investigation of factors involved showed that purification to 0.2-1.5 g./m.³ can be effected in a single stage electrostatic precipitator provided the temperature of the incoming gas is kept between 70° and 90° C., its moisture content 100-130 g./m.³, speed 0.3-0.4 m./sec., time in the electrostatic field 6.5-10 sec. The tension of the latter should be between 35,000 and 44,000 volts with a current consumption of 10 to 30 amperes. For final cleaning moisture content and temperature have less influence. To produce gas containing 20-50 mg. dust/m.³ 30°-40° C. temperature, speed of 0.8-1.3 m./sec., time in the apparatus 2-4 sec., tension of 37,000-45,000 volts and 25-40 amperes current are satisfactory. (2b)

3. MELTING, REFINING AND CASTING

Metal Castings. H. L. Campbell. John Wiley & Sons, New York, 1936. Cloth, 6 x 9 inches, 318 pages. Price $3.00.

This is a text book, written for use at the Univ. of Michigan. In extremely concise form it describes the raw materials of the iron, steel and non-ferrous foundries, the melting and molding equipment, the fundamentals of melting and molding, the properties desired in molding and core sand, the properties and cost of the usual foundry alloys and deals briefly with die, permanent mold and centrifugal casting. Now and then the brevity of statement leads to the failure to mention alloys of importance, such as the Ford crankshaft alloy, but what errors there are, if they are to be classed as errors, are chiefly those of omission. Nobody will become a foundry expert just by reading the book because it does not go into real detail on any one topic, but for a well-balanced general presentation of the important fundamentals it is hard to beat. It is easy reading and would be as useful an introduction to foundry practice for home study as for a college course. Even the old and experienced foundryman might well get a copy to loan to younger men in the organization for many questions that the youngster would ask are answered more clearly and concisely by Campbell than in most other reference courses. H. W. Gillett (3) -B-

Molding and Founding (Formerei und Giesserei) A. Velten. Max Jänecke Verlag, Leipzig, 1936. Boards, 5¾ x 8¾ inches, 148 pages. Price 3.20 RM.

This book is an eleventh edition and bears all the earmarks of a good old book which has not been kept up to date. As a text book for engineering students it probably would convey some idea of the general principles of founding and of the technical complexities involved, but as a book for a man actually practicing in the foundry, it would be woefully deficient. It covers practically every conceivable operation in the foundry and necessarily must be very brief and sketchy in each item. Some serious changes of emphasis are apparent to the modern reviewer. More space is given to crucible melting in the gray iron foundry than is given to electric furnaces. No mention is made of alloy cast iron; nothing is said about refractories, either in furnace lining or ladle, or the chemical effect of acid or basic refractories; no mention of desulphurizing; nothing is said about rotary furnaces, either the powdered coal type or the electric furnace type. The old Roechling-Rodenhauser is the only electric induction furnace mentioned. Nothing is said of the effect of temperatures on cast iron and nothing about the health of the workmen and the important problems of dust removal. About the one modern thing the author seems to have over emphasized is the discussion of die-casting, which occupies 11 of the 17 pages devoted to the founding of non-ferrous metals. J. T. MacKenzie (3) -B-

You don't call a plumber to fix a clock!

And when that very personal machine, your body, gets out of kilter, you don't call a carpenter. You call a *specialist*—a doctor—a *good* one.

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Portland Cement as a Binder for Sand Molds and Cores. V. M. ANDREEV. *Metallurg,* Vol. 11, Apr. 1936, pages 60-69. In Russian. Cores and molds for cast Fe and bronze castings were made using: sand 78%, cement 15% and water 7%. Water turbine wheels were cast with very good results. The mixture is strong, porous and so plastic that no doctoring is required giving clean and accurate castings. A comprehensive laboratory investigation on different factors entering these mixtures is presented. (3)

Technical and Economical Points of View in the Manufacture of Aluminum Sand and Chill Mold Castings (Technische und wirtschaftliche Gesichtspunkte bei der Herstellung von Aluminium-sand- und Kokillenguss) A. v. ZEERLEDER. *Aluminium,* Vol. 18, May 1936, pages 203-208; *Aluminium & the Non-ferrous Review,* Vol. 1, May 1936, pages 365-370. The principles to be applied to economical construction with Al and light metal castings are discussed. The low elasticity modulus requires quite different sections from heavier metals. The influence of casting temperature and cooling is discussed and expressed in a table for different materials:

	av. tensile str. for		
alloy	sand castings kg./mm.^{2}	chill mold castings kg./mm.^{2}	percent of sand castings to chill mold castings
German alloy	15.5	18	86
American alloy	14.0	17.5	80
silumin	17.5	20.5	85
silumin β (not heat-treated)	18.5	24.0	77
silumin γ (heat-treated)	27	29	93
Y-alloy (not heat-treated)	17.5	23	76
Y-alloy (heat-treated)	25	27	93
alufont II	27	30	90
peraluman 7	18	25	72
anticorodal	25	28	29

Costs of castings, labor and overhead, are compared for silumin and cast Fe. Chill mold casting should be preferred to sand castings and are, under certain conditions, cheaper than grey Fe. 5 references. Ha + JCC (3)

Some Points in the Modern Production of Castings. A. PHILLIPS. *Foundry Trade Journal,* Vol. 54, Jan. 30, 1936, pages 102-107, 110. Paper presented to the Burnley section of the Institute of British Foundrymen. Molding and sand preparation, chemical and physical properties of molding sands, durability or ability with which sand can be used and re-used, oil sand cores, mechanized plant, alloy cast irons, drying, venting and pouring molds, cupola operation, etc. are discussed. The paper is illustrated with photomicrographs of different grade sands and with pictures of the mold conveyor of the pendulum type, of sand hoppers and special ramming facilities, push-plate conveyor supplying the hoppers, etc. AIK (3)

How Ford V-8 Crankshafts are Cast and Machined. W. F. PIOCH. *S. A. E. Journal,* Vol. 38, May 1936, pages 21-24. Description of procedure including details of core box preparation. No straightening operation is used, heat treatment is made before machining. Methods of balancing and finishing by polishing are reviewed. Cast shaft has double fatigue resistance of forged shaft and wear resistance is greater. WB (3)

Machine Moulding. D. R. KINNELL. *Foundry Trade Journal,* Vol. 54, Feb. 13, 1936, pages 137-140. Paper presented to the Middlesbrough Branch of the Institute of British Foundrymen. The author deals with machine molding and mentions some of the various examples of light-type castings which can be made successfully on small machines. The castings described weigh less than 40 lbs. each. Machine-made castings are more accurate and of better finish, owing to the fact that they are worked off a true plate pattern. Wastage of material such as sand, parting powder, etc., is cut down to a minimum as flasks and plate are made to suit each other. The plate pattern is more accurate when made from metal. The manufacture of the machine plate patterns is not an easy task. There are numerous possibilities to be looked into, the main item being accuracy. The making of machine-plate patterns, flasks, suitable type of molding machine, scope of the machine, organization of machine foundries, etc., are discussed. AIK (3)

Drying Molding Sands in Open Air (Séchage à l'Air libre des Sables de Moulage) GIRAULT. *Revue de Fonderie Moderne,* Vol. 30, Jan. 10, 1936, pages 4-6. Certain surface defects in Fe castings were traced to dirt carried along with the molten Fe, lack of cohesion of the sand in the patterns, and lack of sufficient permeability of the sand which causes boiling and oxides. These conditions and means to avoid them are discussed. Ha (3)

■ 3a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Beryllium Bronze Ingots. B. K. DERING & D. M. ZASLAVSKY. *Tzvetnuie Metallui,* May 1935, pages 94-102. In Russian. The technique of melting and casting Be bronzes developed by experimental work is described, and foreign practice is reviewed. Structure and properties of cast and worked metals are considered. BND (3a)

Pressure Die Castings in Brass. HERBERT CHASE. *Iron Age,* Vol. 137, May 7, 1936, pages 40-41, 103-105. Brass die castings can be made within closer dimensional limits as well as in thinner sections and in more complex forms than brass sand castings and forgings. Using metal at melting point rather than liquid metal increases the life of die. Some of the alloys used for die castings are Doler brass of about 1% Si; Brastil of 5% Si; a white Ni brass of 5% Ni and 12% Mn; and Mn bronze of 3.5% Mn maximum. Some of the general rules which apply to sand castings apply also in die castings. Shows some of the diverse types and sizes of die cast brass parts. VSP (3a)

Aluminum Refining (Aluminium-raffination) *Chemiker Zeitung,* Vol. 60, May 27, 1936, page 437. A new French process is described, based on the electrolysis of a molten mixture of 23% AlF_3, 17% NaF and 60% $BaCl_2$. Because the electrolyte melts below 750° C. the use of conventional refractory containers is possible and the difficulties attendant on water-cooling the walls in other processes are obviated. In one plant total current consumption is 10,000 amp., current density 40 amp./dm^2 at 7 volts. Current efficiency at the anode is 100% and at the cathode 97%. FPP (3a)

Metal Production in Russia. *Electrical Review,* Vol. 118, May 22, 1936, page 736. Abstract from *Electrochestwo.* Deals with electrical equipment of various plants for the production of Cu, Zn, and Al. MS (3a)

Non-ferrous Melting. H. W. BROWNSDON. *Metal Progress,* Vol. 29, Apr. 1936, page 43. See "Metal Melting," *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 2R/2. WLC (3a)

Changeable Cores for a Die Casting Die. E. STEVAN. *American Machinist,* Vol. 80, Jan. 15, 1936, pages 46-47. Interchangeable pads permit using one set of tools for a multiplicity of gages. Ha (3a)

Practical Aspects of Die-Castings. N. G. D. ROBERTSON. *Metal Treatment,* Vol. 2, Spring 1936, pages 29-31, 33. A general account of the characteristics of pressure and gravity die castings. JCC (3a)

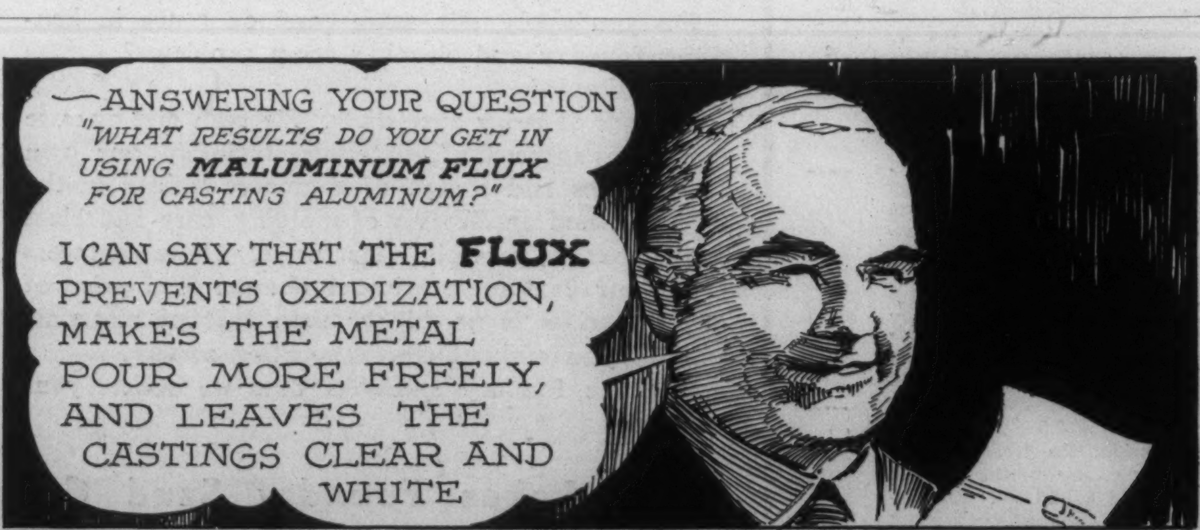
Purification of Gallium by Fractional Crystallisation. JAMES I. HOFFMAN & BOURDON F. SCRIBNER. *Metal Industry,* London, Vol. 47, Nov. 29, 1935, pages 537-538. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 53L/6. HBG (3a)

Production, Properties and Uses of Refined Aluminum (Etude sur la fabrication, les propriétés et les emplois de l'aluminium raffiné) ROBERT GADEAU. *Journal du Four Electrique,* Vol. 45, Jan. 1936, pages 17-22. **Refining of Aluminum (Die Raffination von Aluminium)** *Aluminium,* Vol. 18, Jan. 1936, pages 14-18. See *Metals & Alloys,* Vol. 7, May 1936, page MA 228L/8. JDG + Ha (3a)

Large Centrifugal Castings. *Metal Industry,* London, Vol. 47, Dec. 13, 1935, page 585. A description of the centrifugal casting plant and practice of Messrs. Millspaugh, Ltd. at Sheffield, Eng. Bronze tubes 44″ dia. x 30′ length, weighing up to 50,000 lbs. have been cast for the paper machinery industry. The present capacity of the machines used is from 13″ to 50″ dia. and lengths up to 32′. Steam power is used. Both steel and non-ferrous tubes are produced. HBG (3a)

Recovery of Thallium from Zinc Retort Dusts. C. C. DOWNIE. *Metal Progress,* Vol. 29, Mar. 1936, page 72. Descriptive. WLC (3a)

The New Barronia Foundry at Gunnersbury. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, pages 320-323. An illustrated description of a new bronze foundry using 6 oil-fired furnaces. Products include "Barronia" bronze and "Berdo" nickel and phosphor bronzes. JCC (3a)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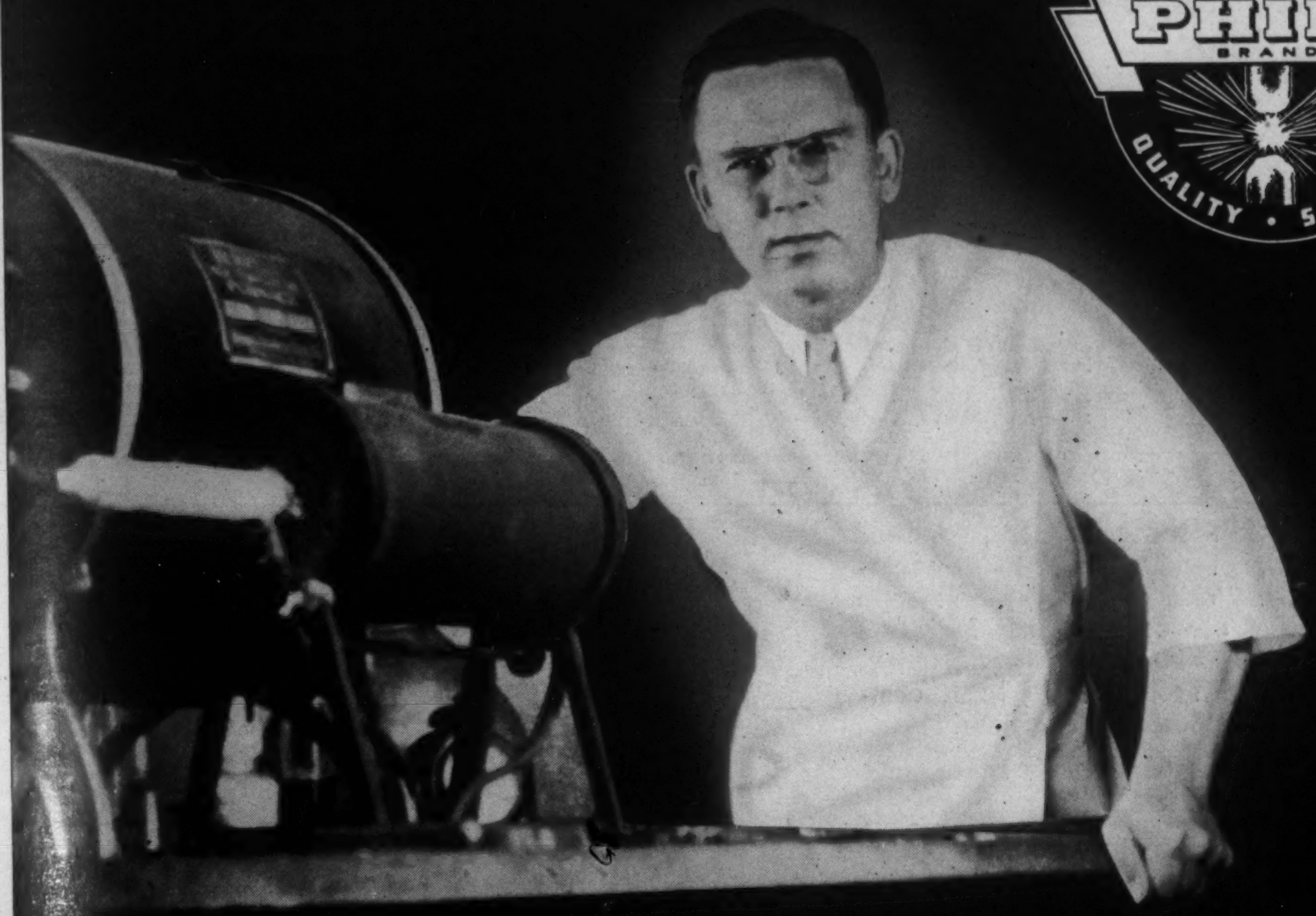

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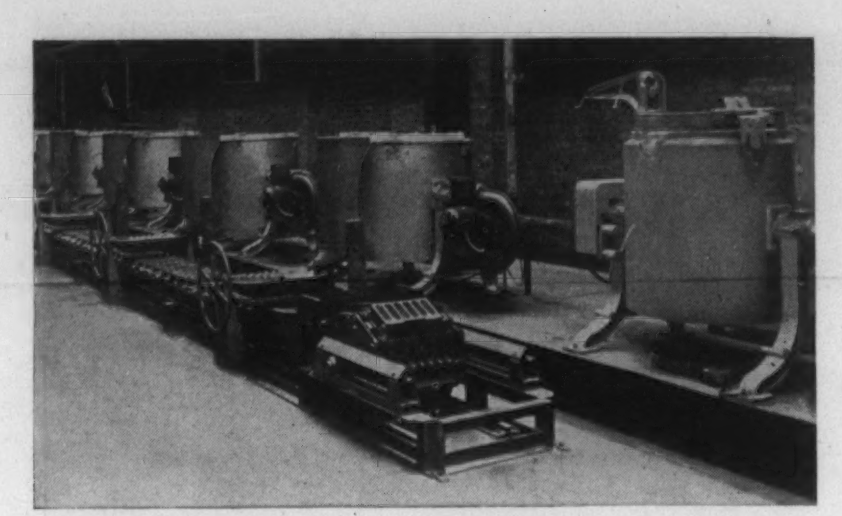

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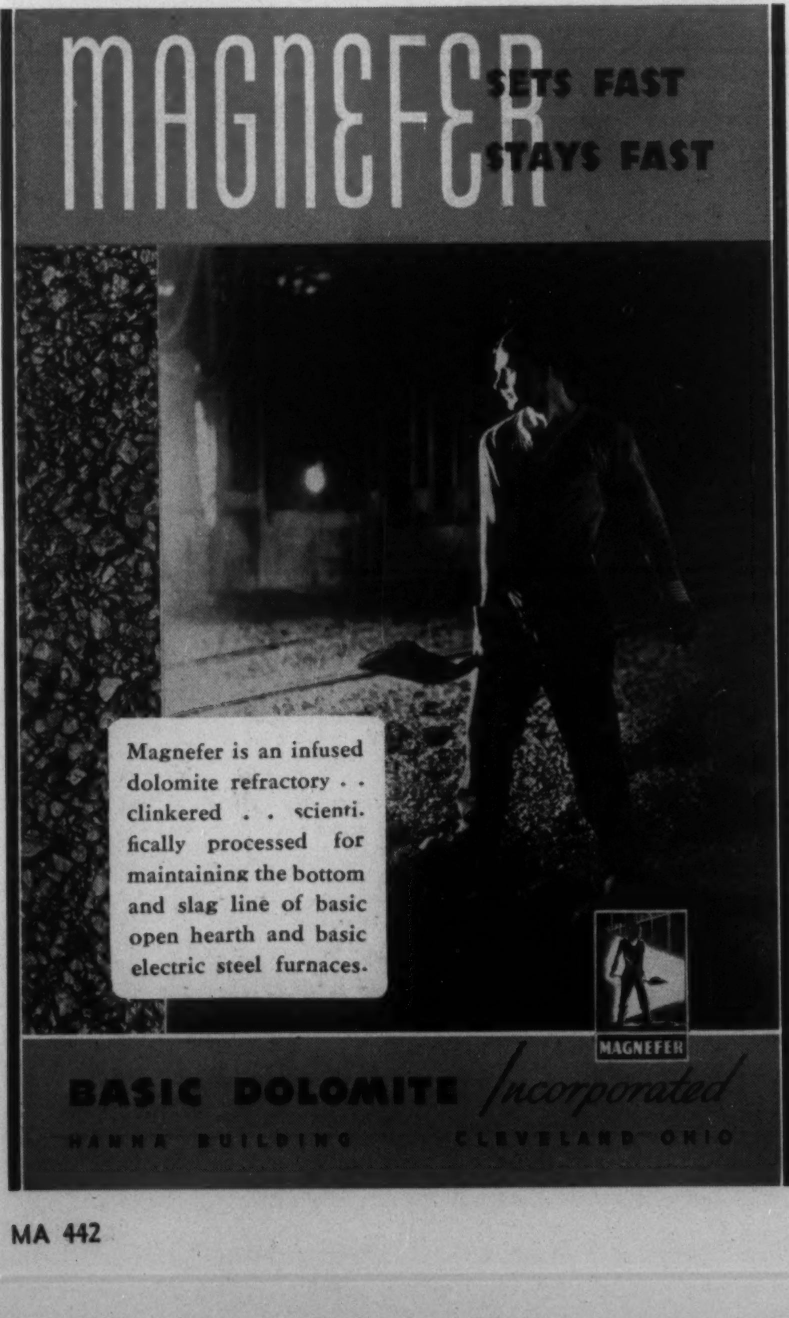

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Electrometallurgy Forges Ahead. Arthur Zentner. *Engineering & Mining Journal,* Vol. 137, Feb. 1936, pages 93-94. New developments in Al, Cu, Pb, Zn, and Cd are outstanding features of 1935. WHB (3a)

The Production and Control of Bronze Castings. Francis W. Rowe. *Metal Industry,* London, Vol. 47, Nov. 8, 1935, pages 459-463, 475. See *Metals & Alloys,* Vol. 7, June 1936, page MA 282R/6. HBG (3a)

Deoxidation and Degasification of Nickel Silver Alloys. R. J. Keeley. *Transactions American Foundrymen's Association,* Vol. 7, Feb. 1936, pages 251-255. The successful production of NiAg castings, while difficult, may be satisfactorily accomplished by proper attention to details. The following points may be helpful in the production of NiAg: (a) Pour at a sufficiently high temperature, the proper pouring temperature will vary with composition. (b) For sand castings containing more than 3% Pb, deoxidize with: 0.10% Mn (as 30% Mn-Cu), added a few minutes before drawing the crucible followed by 0.05% Mg (as stick Mg) just before pouring. (c) For sand castings containing below 3% Pb, deoxidize with up to 0.25% Si (as 10% Si-Cu). (d) Al should be excluded from all NiAg castings which must be pressure tight. Where pressure tightness is not involved and the sections are uniform the addition of 0.5% Al may be recommended for some purposes and in light sections such as typewriter parts, up to 3% has been successfully used. (e) The presence of either Si or Al requires more generous provision for feeding liquid metal to the castings. (f) The presence of Si, Mg or Al is objectionable in rolling mill alloys. CMS (3a)

Copper Tubing—Its Manufacture, Standards and Importance in Refrigeration. O. Z. Klopsch. *Refrigerating Engineering,* Vol. 31, Mar. 1936, pages 162-165, 179. See *Metals & Alloys,* Vol. 7, June 1936, page MA 382R/8. WB (3a)

3b. Ferrous

C. H. HERTY, SECTION EDITOR

The Basic-Bessemer Plant of Stewart & Lloyd in Corby, England (Das Thomas-Stahlwerk der Firma Stewarts & Lloyds in Corby) F. Lilge. *Stahl und Eisen,* Vol. 56, May 7, 1936, pages 537-544. A detailed description of the plant which has three 30-ton basic bessemer converters. SE (3b)

The Metallurgy of the Accompanying Elements in Steel (Zur Metallurgie der Eisenbegleiter) F. Körber. *Stahl und Eisen,* Vol. 56, Apr. 9, 1936, pages 433-444. It is shown that the formation of silicides, phosphides, and carbides in molten Fe influence the equilibrium between the melt and the oxides in the slag. The reducing effect of Si and C on oxides is lowered by the formation of compounds of these elements with Fe and Mn. Moreover the equilibria between the [Fe, Mn, Si] in the bath and the (FeO, MnO, SiO_2) in the slag are also affected by the presence of elements like Ni which do not form definite compounds with Fe and Mn. The reactions of Cr with MnO and SiO_2 of acid slags are depicted in a diagram, this indicating the Cr content of Mn silicate inclusions formed in the deoxidation of Cr bearing steels with Mn and Si. The behavior of V in acid and basic slags is illustrated. With acid slags V is more weakly reducing than Mn; the reverse is true with basic slags. When V is used in conjunction with Mn alone the deoxidizing effect of as little as 0.1% V is noticeable; when used with Mn and Si the deoxidizing effects of the latter overshadow the effect of V. SE (3b)

Melting Ferromanganese in a Tar-Oil Furnace (Das Schmelzen von Ferromangan im Teerölofen) J. Hoag. *Stahl und Eisen,* Vol. 56, Jan. 9, 1936, pages 40-47. The use of molten ferromanganese in steel-making makes possible a saving in Mn because greater accuracy in the desired steel analysis is obtained, than when solid FeMn is used. Molten FeMn is recommended, and tar-oil furnaces for this purpose are described and costs given. SE (3b)

Progress in the Gas Analysis of Steel and Ferro-Alloys by Vacuum Fusion (Fortschritte bei der Gasbestimmung in Stahl und Ferrolegierungen durch Vacuumschmelzung) R. Castro & A. Portevin. *Archiv für das Eisenhüttenwesen,* Vol. 9, May 1936, pages 555-562. An improved vacuum fusion train using a spiral C resistor furnace and the method of gas analysis are described in detail, various sources of error being pointed out. Very satisfactory results were obtained. SE (3b)

Studies of the Chemistry of the Acid Open-Hearth Process (Untersuchungen über die Chemie des sauren Siemens-Martin-Verfahrens) H. Schenck & E. O. Brüggemann. *Archiv für das Eisenhüttenwesen,* Vol. 9, May 1936, pages 543-553. With the aid of observations of acid open-hearth melts the equilibria of the Mn and Si reactions and the partition of FeO between bath and slag were redetermined and represented by equations and diagrams. The results were compared with those of Körber and Oelsen and other observers and some discrepancies indicated. SE (3b)

The Distribution of Sulphur Between Metal and Slag in the Basic and Acid Processes of Steel Manufacture. E. Maurer & W. Bischof. *Iron & Steel Institute,* Advance Copy No. 12, May 1936, 17 pages. Previous work on the behavior of S in steel-making processes is reviewed. Distribution of S was studied from numerous operating data from basic open-hearth process. These disclosed the powerful desulphurizing effect of Mn. The influence of SiO_2 content of slag was determined and shown as curves. The influences of MgO, Al_2O_3, and P_2O_5 in the slag and P in the metal were also considered. The behavior of S in the acid process is discussed in light of data secured from operating heats. These data reveal a dependence of S distribution on the P content of the metal. 22 references. JLG (3b)

Production of Cast Steel Locomotive Cylinder (La Fabrication des Cylindres en Acier Moulé pour Locomotive) E. Lecoeuvre. *Bulletin de l'Association Technique de Fonderie,* Vol. 10, Jan. 1936, pages 2-32. A very detailed account of casting method for steel locomotive cylinder, including preliminary study, intermediate steps, heat treatment, and time studies. Includes 72 sketches and tables. WHS (3b)

4. WORKING

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Rolls for Rolling Mills. New Method of Making. Dynamic Solidification (Solidyna) (Les cylindres de laminoirs. Une technique nouvelle de fabrication. La solidification dynamique (Solidyna)) L. Quincy. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 265-279. Rolls are cast in molds which are then closed and rotated around their axis until the metal solidifies. Centrifugal force eliminates influence of force of gravity so that the shrinkage cavity becomes centrally located and has a cylindrical shape. Grain size is refined, dendritic crystallization prevented and all non-metallic impurities are segregated on the surface of the internal cavity. The surface of the latter is free from oxidation. Speed of rotation at the start of solidification is equal to $n = 4548:VD$ and at the time of formation of shrinkage cavity $n = 1272:VD$ where n is number of revolutions and D the limiting diameter of the liquid layer in mm. For a roll with the diameter of the body of 400 mm. and of the neck of 240 mm. the respective speeds would be 290 and 127 r.p.m., but for practical uses 300-350 r.p.m. for cast Fe and 400-450 r.p.m. for steel are preferable. Major advantages of the process as compared with centrifugal casting of the usual type are: less destruction of the molds, possibility of handling heavy rolls, slow speed of rotation required in final stages of operation, freedom from shrinkage cavities which must occur in usual centrifugal casting of rolls and the lack of oxidation of the surface of consecutive layers of frozen metal. In the latter case solidification proceeds exclusively from the periphery towards the center. Longitudinal segregations are totally prevented, while radial segregations are practically of the same order of magnitude as in rolls cast in stationary molds. Internal cavity increases the elasticity of the rolls and facilitates their heat treatment. Largest roll cast by the new process measured 1200 mm. diameter and 3 m. length of the body. Rolls compare favorably with forged steel rolls and are more wear resistant than cast Fe rolls, particularly when they contain some Cr. JDG (4a)

Hot Strip in 3200-Lb. Coil Handled Over 450-Ft. Conveyor System. F. L. Prentiss. *Iron Age,* Vol. 137, Mar. 26, 1936, pages 58-61. Describes conveyor system used to handle coils in continuous flow from hot strip mill to hot strip finishing department at the McDonald works of the Carnegie-Illinois Steel Corp'n. VSP (4a)

The Measurement of the Temperature of Hot Moving Objects. A. E. Krough. *Iron & Steel Engineer,* Vol. 13, Apr. 1936, pages 11-12. Describes equipment for indicating and recording the rolling temperatures in hot strip and other rolling mills. WLC (4a)

Roll Design in Four High Mills. B. A. Ivanov. *Metallurg,* Vol. 11, Apr. 1936, pages 16-21. In Russian. Mathematical treatment of roll design including crown. (4a)

Descaling Hot Steel Hydraulically. J. E. Holveck. *Iron & Steel Engineer,* Vol. 13, Apr. 1936, page 10; May 1936, pages 1-12. Paper presented and discussed at A.I. & S.E.E. Engineering Conference, Youngstown, Apr. 1936. Suggestions regarding nozzles and pump-accumulator equipment and their use in descaling of hot steel with high pressure water. WLC (4a)

Tinplate and Sheet Rolling Systems. J. Selwyn Caswell. *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, page 349; May 1936, page 429; June 1936, page 525. From *South Wales Evening Post,* Jan. 10, 1936. Outlines outstanding characteristics of modern rolling practice for production of thin flat products, discusses systems of reducing thickness of strip to tin plate gages, and suggests means of modifying existing practice in South Wales. MS (4a)

Constant Speed Arrangement for Continuous Rolling Mills (Gleichlaufeinrichtung für kontinuierliche Walzwerke) H. Brauner. *Siemens-Zeitschrift,* Vol. 16, May 1936, pages 156-159. In continuous rolling mills where the material is in several rolls at the same time the speed of the rolls is adjusted automatically so that the material between 2 adjacent rolls is neither stretched nor looped. This is obtained by synchronous motors driven by the roll stands; these motors all have the same number of revolutions if the rolling stands have correct speed, and in case of deviation the slip currents act on the speed regulation of the roll motors. An installation is described. Ha (4a)

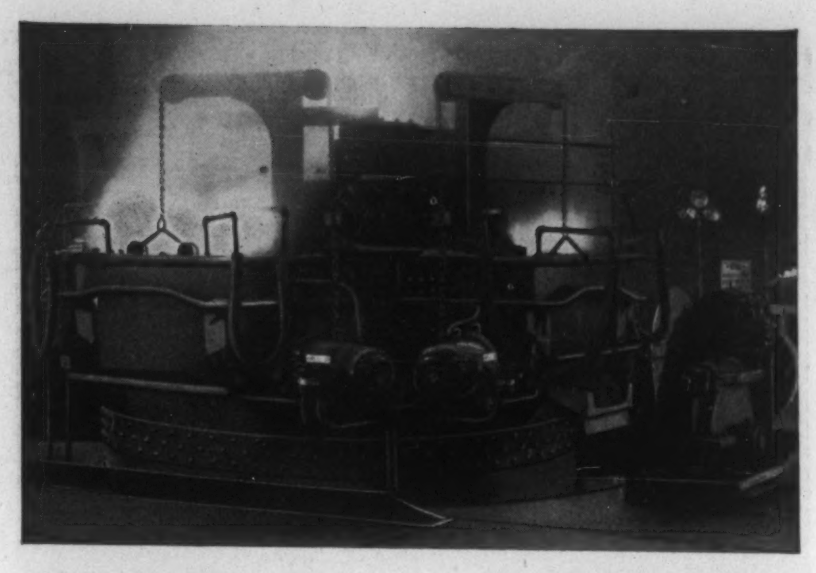
4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Bolts and Nuts. W. S. Stambridge. *Times [London] Trade & Engineering,* Vol. 38, Dec. 1935, page XII. Brief outline of evolution in methods and improvement in quality of metals used, with special reference to practice in West Midlands district, England. MS (4b)

Forging Aluminum Bronze. N. V. Okromeshko & F. I. Maslennikov. *Tzvetnuie Metallui,* June 1935, pages 55-57. In Russian. The authors investigated an Al-bronze (9-11% Al, 3-5% Fe, 1-1.5% Mn, 0.03% P) with the object of establishing optimum forging temperatures and degrees of reduction. Tests showed that optimum mechanical properties are obtained under following conditions: casting temperature 1000°-1050° C., temperature of mold 200°-300° C., forging temperature 900°-600° C., reduction in forging to 75% increase in length. BND (4b)

The Manufacture of Alloy Stampings. *Aircraft Engineering,* Vol. 8, June 1936, page 175. Brief review of drop forging of Al alloys for crankcases, pistons, connecting rods and propeller blades. Only several 10/1000" tolerance is allowed for machining after stamping. Ni-Cr-Mo or C steels are used for dies with hardness of 340-440 Brinell. Liquid baths or electric furnaces used for heating alloys to 500° C. max. WB (4b)



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Drop-forging Insert Dies. J. H. Skerka. *American Machinist,* Vol. 80, Apr. 8, 1936, pages 298-300. Economies obtained by proper preparation of blanks and use of insert dies are described. Ha (4b)

The Manufacture of Tubular Aluminum Articles by Extrusion. O. Kühner. *Metal Industry,* Vol. 47, Nov. 29, 1935, pages 535-536. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 182L/8. HBG (4b)

The Position of Metal Forming. E. S. Jones. *Metal Treatment,* Vol. 2, Spring 1936, pages 40-41, 52. Steel stampings, forgings, and hot pressings might find wider applications if they were produced with greater accuracy and consistency, with less flash, and with an absence of hard spots, scale, flaws, and surface defects. JCC (4b)

■ 4c. Cold Working, including Shearing, Punching, Drawing & Stamping ■

Drawing Square, Rectangular and Irregular Shapes and Sections. *Wire & Wire Products,* Vol. 11, Feb. 1936, pages 76-77. The recent development of the "Turks Head" for drawing irregular shapes is described. This device consists in principle of 4 hardened rolls highly ground and polished, placed at right angles with each other, the rolls are shaped according to the shape to be rolled. Accuracy, production and economy are said to be superior to other methods used so far. Ha (4c)

■ 4d. Machining ■

H. W. GRAHAM, SECTION EDITOR

Finishing Internal Surfaces. A. W. Schneider. *Mechanical Engineering,* Vol. 58, Apr. 1936, pages 222-224; *Machinery,* London, Vol. 47, Jan. 9, 1936, pages 443-446. The improvements in method and machines for finishing internal surfaces are discussed. Accuracy depends on the machinery methods used; honing, precision boring, grinding and reaming processes are described. WB + Ha (4d)

Built-up Edge on the Single-point Tool. V. D. Prianishnikoff. *American Machinist,* Vol. 80, Apr. 8, 1936, pages 294-297. Chip formation as dependent on material of cutting tool and its shape is studied and the influence of cutting speed, cutting fluid and feed discussed. Micrographs of chips are reproduced. Ha (4d)

Can Machinability be Controlled? J. Haydock. *American Machinist,* Vol. 80, Mar. 25, 1936, page 261. The necessity for uniform quality of materials to be machined and methods to check machinability are briefly discussed. Ha (4d)

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5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

The Heat Treatment of Cast Iron. A. A. Timmins. *Bulletin British Cast Iron Research Association,* Vol. 4, Apr. 1936, Bureau Report No. 148, pages 314-320. Reproduced from Staffordshire Iron & Steel Institute, Vol. 50, 1934-35. See *Metals & Alloys,* Vol. 7, June 1936, page MA 289L/1. WB (5)

Heat-Treatment of High Speed Tool Steels. Richard Saxton. *Sheet Metal Industries,* Vol. 9, Sept. 1935, pages 571-572. Insufficient soaking at hardening temperature is pointed out as a cause for failure though not generally recognized as such. Hardening and tempering operations are set forth. AWM (5)

■ 5a. Annealing ■

A Note on Stress Relieving Monel Metal. *Metals & Alloys,* Vol. 7, Jan. 1936, page 13. 600° C. (1112° F.) anneal for 3 hrs. of rolled Monel plate resulted in increase of proportional limit from 33,000 lbs./in.^{2} as received to 53,000 lbs./in.^{2} without marked effect on tensile strength or Brinell hardness. WLC (5a)

■ 5b. Hardening, Quenching & Drawing ■

Shallow Hardening, Factors Causing It. Francis B. Foley. *Metal Progress,* Vol. 29, Apr. 1936, pages 59-62. Discussion of split transformation on cooling, Ar′ and Ar″, between which austenite transforms directly to fine pearlite or troostite and below which to martensite. The time factor in transformation is influenced not only by temperature and alloy composition but by austenitic grain size and presence of crystalline nuclei whether from undissolved carbides or non-metallics. WLC (5b)

Quenched Steel—Why Is It Hard? Francis B. Foley. *Metal Progress,* Vol. 29, Mar. 1936, pages 52-56. General discussion of development of hardening theories. WLC (5b)

Electrical Treatment for Railway Lines. *Electrical Review,* Vol. 118, June 19, 1936, page 907. Brief description of American equipment for electrical heat treatment of rail ends already laid so as to minimize battering. Rail surface is first ground to correct inequalities. End is preheated by an induction device which places head of rail in the magnetic field of a transformer that is energized with high-frequency a.c. Temperature of rail is raised to proper degree for tempering by an apparatus which, using a train of gears and a cam system driven by a motor, causes an arc to move rapidly over the rail. Another device then applies oil to the head of the rail at a fixed temperature for an exact and controlled period of time. Hardness is thus raised from 260 to 400-450 Brinell. MS (5b)

Rails are Improved by Heat Treatment, by Controlled Cooling. *Metal Progress,* Vol. 30, July 1936, pages 41-45, 102. Cooling rails on special beds at the mill has been controlled to prevent the occurrence of transverse fissures. Heat treatment can be applied as rails cool from the mill by quenching in water at 60°-100° F. for 30 sec. when the edge of the base becomes magnetic, about 1200° F., with head surface 1360° F. and head center 1500° F. This cools the head to about 900° F. when the rails are transferred to a draw furnace maintained at 900° F. for equalizing and slow cooling. 900° F. is higher than the temperature at which the defects resulting in transverse fissures occur. End batter may be helped by local treatment with the oxy-acetylene torch, followed by quenching and drawing, or the rails may be end hardened at the mill. WLC (5b)

■ 5e. Carburizing ■

Heat Treatment Improves Sulphur Screw Stock. L. D. Spence & N. B. McLaren. *American Machinist,* Vol. 80, Feb. 12, 1935, pages 154-156. By correct carburization of high S steel, strength and toughness of the latter could be improved so that it could be machined at higher speeds. Figures are given for speeds after heat treatment at different temperatures. Ha (5e)

Case Hardening and Heat Treatment with Liquid Cyanides. E. G. Bishop. *Heat Treating & Forging,* Vol. 22, June 1936, pages 282-287. Paper read before the Steel Treatment Society of Australia. Discusses advantages and disadvantages of the cyanide method of hardening; dangers in use; operation, chemical reactions; maintenance of NaCN content of bath; effect of various factors on case produced; nitriding; use of accelerated cyanides; reheating carburized parts in cyanide baths; and selection and care of pots. MS (5e)

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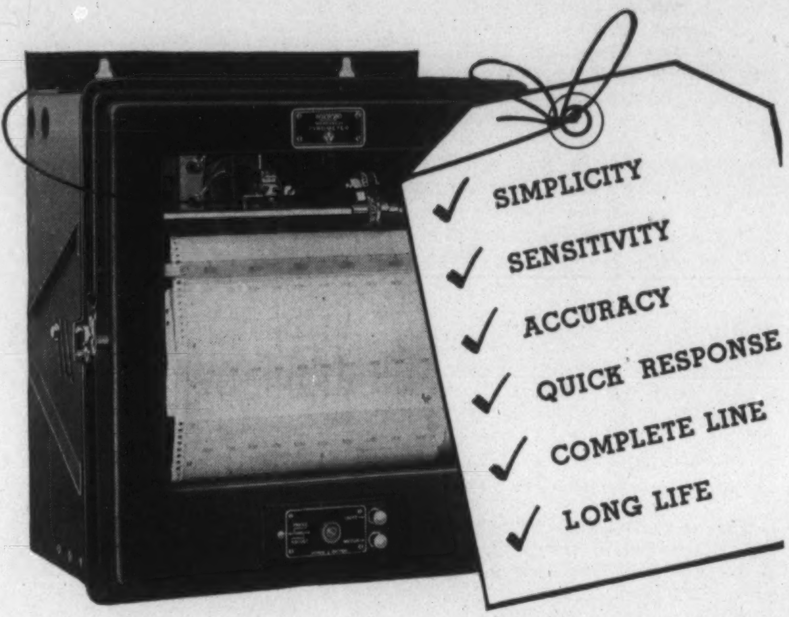

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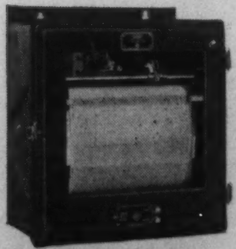

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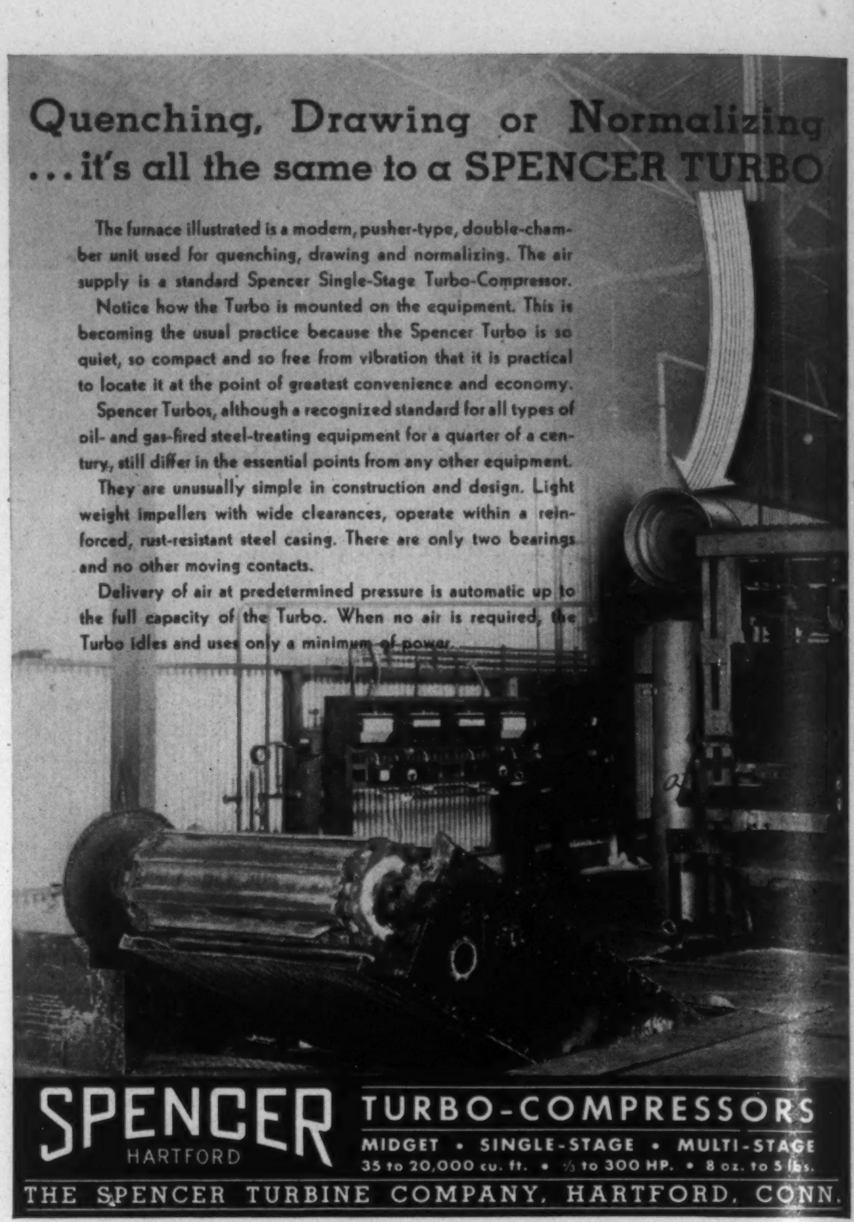

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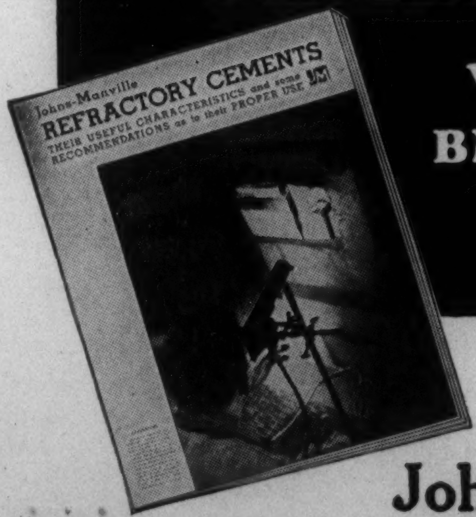
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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Mounting of Furnace on Vibration Absorption Material Prolongs Refractory Life. R. C. Hess. *Industrial Heating,* Vol. 3, June 1936, pages 373-374. Attention is called to the damaging influence which vibrations of building or ground can have on the life of refractories in furnaces which may be destroyed by becoming loose before their useful life is ended by erosion. Placing channels in the floor with material of high damping properties on which the furnace rests is one of the most effective means of preventing vibrations from being transmitted to the furnace. Ha (6)

2

A New Galvanizing Furnace. W. H. Spowers. *Wire & Wire Products,* Vol. 11, June 1936, pages 286, 293, 300; *Industrial Heating,* Vol. 3, June 1936, pages 375-378; *Blast Furnace & Steel Plant,* Vol. 24, June 1936, pages 512-513, 538. **Galvanizing Kettle Heated Through Gas-fired Vertical Alloy Tubes in Walls.** *Steel,* Vol. 98, June 8, 1936, pages 56, 58. To prevent local overheating by a flame the direct impinging of the flame on the pot walls is prevented. Only glowing material either heated by flame or electrically is used for heating. Formation of dross was materially reduced. Constructive details are described. Ha + MS (6)

3

Insulation of Soaking Pits Improves Operation. S. M. Jenkins. *Steel,* Vol. 98, Mar. 9, 1936, pages 64, 67-68. Efficiency of soaking-pits can be greatly improved with little extra cost by constructing them of thin fire-brick walls insulated with high-temperature insulating brick and a sheet steel or concrete outer protecting wall. Steel or concrete casing prevents air infiltration. Presents results of tests on a recent installation, and on basis of these and additional tests on open-hearth regenerators tabulates insulation recommended for ideal soaking-pit. Soaking-pit covers also afford excellent opportunity for insulation. Insulation of recuperative type soaking-pits assures uniform heating, aids in low fuel consumption, and improves product. MS (6)

4

Industrial Liquefied Petroleum Gases. M. J. Conway. *Industrial Heating,* Vol. 3, June 1936, pages 363-366, 372-374. The advantages of saturated gaseous hydrocarbons, ethane, methane, propane and butane, as fuels are discussed and methods of producing and distributing them described. A table is given showing the rapidly growing use of propane and butane as fuels and their thermal properties. The same equipment as for natural gas can be employed. The price today is competitive with other fuels. Ha (6)

5

Refractories. *Times* [*London*] *Trade & Engineering,* Vol. 38, Jan. 1936, page XVIII. Reviews improvements made and research conducted during 1935. MS (6)

Heat Expansion Compensation on Invar Links (Wärmedehnungsausgleich an Invargliedern) W. Hiebsch. *Elektrowärme,* Vol. 6, June 1936, pages 190-192. As the temperature coefficient of invar increases with increasing temperature and is, at 500° C., about the same as that of other alloys arrangements are described to compensate for this changing thermal expansion by other suitable alloys in order to obtain accurate temperature control devices. Ha (6)

Refractories in the Foundry and Furnace. W. Hamilton. *Foundry Trade Journal,* Vol. 54, Jan. 30, 1936, page 101. Paper read before the Scottish Branch of the Institute of British Foundrymen. There is much in favor of using the Chammote type of material for certain molds, such as rolls or exceptionally heavy castings with a quantity of machined parts, as the free escape of gases through the material, after the mold has been filled with metal is very important factor. It improves the appearance of a casting generally, besides reducing machining allowance. Rapid strides have been made in the use of oil sands for cores and even molds during the last few years, so much so that in some foundries hundreds of tons of castings are made solely by this means. Sea sand, silica sand, and sometimes pit sand are the most favored, and extremely reliable bonding materials can be obtained from any of the various makers. For facing, there is now available a siliceous clay which, when used properly, can give good results both on sand and composition molds for steel castings. Linings for furnaces and refractory bricks are also discussed by the author. The cupola, which in the past was wholly lined with firebricks and patched with ganister or some proprietary material, gave quite good results; today the monolithic lining has appeared, and though its progress has been slow, the results obtained are making the average foundrymen consider the advisability of ramming up his cupola instead of relining with bricks. AIK (6)

Electric Furnaces for Case Hardening (Elektrische Oefen zum Einsatzhärten) G. Jabbusch. *Elektrowärme,* Vol. 6, June 1936, pages 177-184. Batch and continuous furnaces are described, operating data given. Ha (6)

Recent Improvements in Electric Furnaces with Crossed Channels (Les récents perfectionnements des fours électriques à canaux croisés) Jean Kuntziger. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 244-246. Structural details of a resistance furnace using liquid resistor elements. JDG (6)

Heat Treating and Forging at the Ford Motor Company. W. C. Kernahan. *Heat Treating & Forging,* Vol. 22, June 1936, pages 273-281. Describes equipment and practice in plant at Dearborn, Mich., with much attention to the furnaces. Tabulates composition of the steels used. MS (6)

TAYLOR REFRACTORY INSULATING BRICK

Performance Report — **Subject:** Heat-treating, natural gas furnace, 39x39x39", with alloy steel muffle 13" high by 16" wide by 32" deep. Six inspirator type burners, with complete combustion in the SRM burner tunnel. Walls of 4½" Taylor Refractory Insulating Brick and 2½" Sil-O-Cel—total thickness of 7", with a 9" arch of Taylor Refractory Insulating Brick.

Furnace is used for heat-treating alloy tool steels preliminary to oil or water quench. Also used for carburizing.

Rate of Heating—Fuel Consumption—Processing— For processing alloy tool steel, furnace is lighted at 7:20 a.m. at a temperature of 325° F. Thirty minutes later it has reached 1550° F. with a fuel consumption of 332 cu. ft. per hour. Processing 251 pounds of alloy tool steel in three heats required 12 hours, at temperatures ranging from 1430° F. to 1825° F.

Heat No. 1—373 cu. ft.; heat No. 2—550 cu. ft.; heat No. 3—235 cu. ft.; making a total of 1158 cu. ft.

Carburizing at 1700° F., a 150-pound charge is placed in the furnace at 4:40 p.m. at 1000° F. At 6:00 p.m. temperature has reached 1700° F., and after five hours at this temperature, the charge is removed with a total gas consumption of 672 cu. ft. Depth of case is .05".

What this means to you!

Processing—Accepting the above figures as average production, with fuel costing 50 cents per 1000 cu. ft., 251 pounds of high-priced alloy tool steel is processed at a cost of $0.579 or $0.0023 per pound.

Carburizing—a charge of 150 pounds is carburized at a cost of $0.336 or $0.00224 per lb.

If you would have further information regarding the possibilities of Taylor Refractory Insulating Brick, write for the booklet—or consult our Engineering Department.

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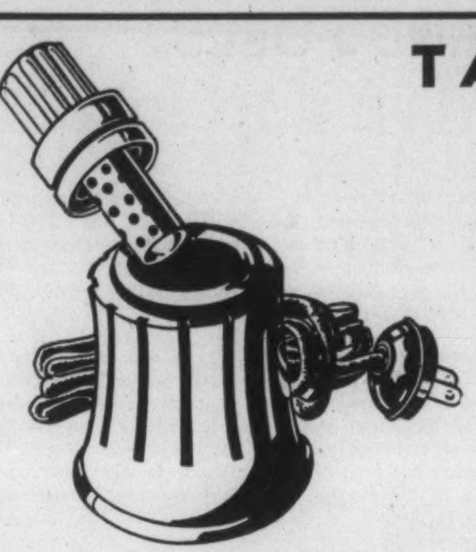

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SOUTHPORT CONN.

Measurements with a New Color Pyrometer (Messerfahrungen mit einem neuen Farbpyrometer) K. GUTHMANN. *Stahl und Eisen,* Vol. 56, Apr. 23, 1936, pages 481-489. Measurements were made with the new combined color-brightness pyrometer "Bioptix," in the laboratory, blast-furnace, Bessemer, open-hearth, and foundry furnaces, and of forged and rolled parts. For molten steels readings within ± 10° C. of the true temperature were obtained, this being much more accurate than with the usual optical pyrometer. Measurements of flame temperatures were also obtained. SE (6)

Repairs to Electric Melting Furnaces. WALTER LISTER. *Metallurgia,* Vol. 14, May 1936, pages 21-23. Describes ways of building bottoms in arc furnaces. JLG (6)

Electric Furnaces to Bright Anneal High Carbon Steel. WILLARD ROTH. *Metal Progress,* Vol. 29, Jan. 1936, pages 35-38. Describes bell type equipment for annealing tool steel preparatory to cold working and in process. Overall costs on flat stock (razor blade steel) in coils is given as $7/ton for process anneal and $12/ton for the spheroidizing anneal. WLC (6)

The Open-hearth Furnace. Vol. I. W. C. BUELL, JR. Penton Publishing Company, Cleveland, 1936. Cloth, 6 x 9 inches, 276 pages. Price $4.00.

A series of articles by Buell, published in Steel since 1932 on "Improving Open-Hearth Design" is being brought up to date and rearranged into book form, to be published in 3 volumes. This one deals with the supporting steel work, refractories, design of hearth, walls and roof. Vol. 2 is to deal with the contour of the furnace in relation to efficiency, and Vol. 3, the regenerators and other external details. The data presented relate primarily to large basic furnaces rather than to steel foundry furnaces. They have been collected from many representative plants and give a useful picture of present practice.

Problems of heat flow through refractories and the value of insulation are given special prominence in this volume. H. W. Gillett (6) -B-

Ohio Heat Treating Company. W. C. KERNAHAN. *Heat Treating & Forging,* Vol. 22, May 1936, pages 219-222. Describes plant at Dayton, O. Equipment includes a large carburizing furnace, 3 furnaces for hardening alloy and high-C steels, 3 furnaces for hardening high-speed steels, 2 Pb-pot furnaces, 3 salt-bath furnace, a brazing furnace, a drawing oven, 2 cyanide furnaces, and 8 quench tanks. All furnaces are gas fired. MS (6)

Furnace Refractories. F. H. MORTON. *Chemical Trade Journal & Chemical Engineer,* Vol. 98, Apr. 3, 1936, page 285. Abstract of paper read before the Ceramic Society. Deals with development of insulating fire-brick. MS (6)

Electrically Heated Tubular Furnace with Heat Recuperation (Elektrisch beheizter Röhrenöfen mit Wärmerückgewinnung) K. MERTENS. *Elektrowärme,* Vol. 6, June 1936, pages 184-187. Advantages of utilizing the heat of the cooling end of the furnace and of the heated material for preheating the incoming material are explained and construction data for such furnaces and operating data are given. The energy consumption was as low as 120-150 kw.hr./ton of heated material. Ha (6)

Circular Furnace for Ingot Heating. M. H. MAWHINNEY. *Iron & Steel Engineer,* Vol. 13, Apr. 1936, page 6; June 1936, pages 26-29. Paper presented and discussed at A. I. & S. E. E. Engineering Conference, Youngstown, May 1936. Describes new circular ingot heating furnace with advantages claimed as follows, no cold corners, bottom firing, vigorous circulation and many small burners produces maximum temperature uniformity, control of atmosphere automatically through the fuel-air ratio reduces scaling and bottom maintenance. WLC (6)

Induction Heating. J. MARRYAT. *Electrical Review,* Vol. 118, May 29, 1936, page 773. Direct electric heating of metal parts by heavy currents at low voltages permits intense local heating at any desired point, and is highly efficient, economical, and rapid. Large-capacity transformer supplies ample current for particular purpose at 2.5-6 volts. Secondary winding usually consists of a single turn of heavy Cu, part to be heated forming a portion of this turn. Work is held in special H_2O-cooled Cu dies. Process is used for heating bars and pipes for bending; heating railway rolling-stock tires; annealing steel tapes and wires; and upsetting of valves, brake-operating cams, and other parts of automobiles. MS (6)

Annealing Sheet and Strip Steel with the Use of Electric Furnaces. A. N. OTIS. *Iron & Steel Engineer,* Vol. 13, Feb. 1936, pages 1-10. Paper presented and discussed at A. I. & S. E. E. Convention, Pittsburgh, Sept. 1935. Describes preliminary tests in batch and continuous furnaces tending to show that the product from batch furnaces is more uniformly annealed than that from continuous furnaces. These tests indicate an important factor to be watched in the development of continuous furnace design. WLC (6)

Measurements on the Rotary Furnace (Messungen am Drehofen) W. LIESEGANG. *Archiv für Technisches Messen,* Vol. 5, Feb. 1936, pages T19-T20. Measuring instruments and methods and the correct manner and place to carry out the measurement are described for temperatures, waste gases, and analyses of waste gases. 7 references. Ha (6)

High Frequency Furnace in Steel Plants (Le four à haute fréquence dans l'aciérie) D. F. CAMPBELL. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 247-252. A brief survey of contemporary practice. JDG (6)

Electrical Furnaces of a New Type for Melting of Light Metals (Ueber neuartige Elektroöfen zum Schmelzen von Leichtmetall) H. DICKS. *Elektrowärme,* Vol. 6, June 1936, pages 162-171. Present developments are reviewed. Attention is called to the fatigue phenomenon of graphite crucibles which has the effect that, sometimes even after only 6-8 melts, the time for melting is doubled. The reduced heat conduction is ascribed to the combustion of the outer walls of the crucible. By melting brass and Cu in between, the crucible can, however, be recuperated. Metallic heating elements for an energy consumption of 6 watts/cm.² are now obtainable. A low frequency furnace for melting non-ferrous metals is described which uses 450-500 kw./ton of light metal. The life of the melting channel is, however, not as long as for heavy metals; frequent cleaning of the channel or groove from the adhering deposits and a densely tamped material for it are recommended. Operating and construction data of several types are given. Ha (6)

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7. JOINING

The Repair and Reconstruction of Metal Footbridges. *Railway Gazette,* Vol. 64, May 1, 1936, pages 859-860. Various methods used to repair railway footbridges of metal without interrupting rail or foot traffic are described. Riveting is most often used although electric welding offers great possibilities. FPP (7)

7a. Soldering & Brazing

C. H. CHATFIELD, SECTION EDITOR

Soldering and Solders (Löten und Lote) E. Lüder. A. W. F. No. 207, 2nd Edition. Beuth-Verlag, Berlin, 1936. Paper, 5½ x 8¼ inches, 66 pages. Price 1.75 RM.

Concise description of soldering, chiefly hand soldering, with some reference to mechanical soldering. German standards for SnPb solders ranging from 25 to 90% Sn are given. Data for strength of joints soldered with solder containing not over 0.5% Sb and with that containing Sb in amount of 6% of the Sn content are given showing the Sb-free to be generally the better for steel, poorer for Cu and about the same for brass. Brief mention is made of CdZn and of Cu brazing. Standards for brazing spelters and Ag solders and formulae for spelters with Sn or Si additions, for CuNiZn spelters and for AuAgCu solders for precious metals are given. Al solders are discussed with suitable warning as to danger of corrosion. In all cases the proper cleaning and fluxing practice is discussed.

From the point of view of conservation of Sn it is recommended not to cut the Sn content of soft solder too radically, since in the long run more Sn is used. The PbBiCd and other Sn-free Pb solders are not considered to make a generally satisfactory substitute, though usable in some cases. Electric welding is listed as a substitute method often available.

Suggestions are made as to solders for use on steel, cast and malleable Fe, Cu, and its alloys, Ni, and its alloys, and precious metals.

Soldering irons are illustrated with a recess for a Thermit cartridge which is ignited and heats the Fe to the proper temperature.

The pamphlet does not go into great detail on any topic, but is a useful introduction to the subject and cites the German standards so that from that point of view it is a useful reference book. It is not exhaustive enough nor does it give enough references to get the reader very far along any special line. For example, the paragraph on Cu brazing of steel says nothing about the proper order of clearance in the joint and the treatment of many other subjects is equally sketchy. H. W. Gillett (7a) -B-

Fluxes for Soldering—Suggestions for Metals and Alloys. *Chemical Engineering & Mining Review,* Vol. 28, Dec. 9, 1935, pages 51-52. Two general classes of fluxes are in common use: (1) includes substances of the type of tallow, resin, olive oil, etc., and (2) includes Zn-chloride, ammonium chloride, and HCl. Fluxes for general purposes are tabulated and fluxes for stainless steel, Al, and pewter are considered separately. WHB (7a)

* * *

Hard Soldering of Beer Conduits of Aluminum (Hartlöten von Bierleitungen aus Aluminium) K. Heinemann. *Aluminium,* Vol. 18, Mar. 1936, page 103. Instead of rather costly mechanical joints by screw and flange, hard soldering of Al pipes with Al rich solders (70-95% Al, with Cu, Ni, Ag, Mn, Zn, Sn, etc.) has given entire satisfaction both as to reliability and hygienic considerations. The soldered joint is made V-shaped. Ha (7a)

Broken Shaft of Large Rock Crusher Salvaged by Braze Welding. G. W. Irwin. *Iron Age,* Vol. 137, Apr. 2, 1936, pages 36-38. Describes the salvage of a broken rock rusher shaft by braze welding. The shaft was 14″ to 18″ in diameter, 12′ long and weighed 7 tons. Materials used for the job were 125 lb. of Airco 22 bronze, 4 lb. of Marvel flux, 500 ft.^{3} of acetylene, and 440 ft.^{3} of O. VSP (7a)

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

Welding—A Handy Tool. A. F. Davis. *Welding Journal,* N. Y., Vol. 15, May 1936, pages 19-23. A number of applications of arc welding are described and illustrated. WB (7b)

All-Welded Structural Steel Low-Height Flat Car. Charles Schenck. *Welding Journal,* N. Y., Vol. 15, June 1936, pages 2-5. Saving of 15% of weight of usual railroad car and lower height made possible by welding; details and photos shown. WB (7b)

Welding of Ni and Its Non-ferrous Alloys (La soudure du nickel et de ses alliages non-ferreux) A. Boutte. *Métaux,* Vol. 10, Dec. 1935, pages 341-346. General discussion on welding of Ni and its alloys. GTM (7b)

Illinois Cornfield Becomes Diesel Locomotive Works. *Iron Age,* Vol. 137, Apr. 16, 1936, pages 38-40, 53. Describes the Diesel locomotive works of the Electro-Motive Corp., division of General Motor Corp., at La Grange, Ill. Electrically welded structural steel throughout 9 buildings affords an unusual application of welding. 50,000 ft. of welding and 7½ tons of electrodes were used in erection of more than 2000 tons of structural members. Roof trusses and columns were welded by the Austin Co. and shipped to the site. VSP (7b)

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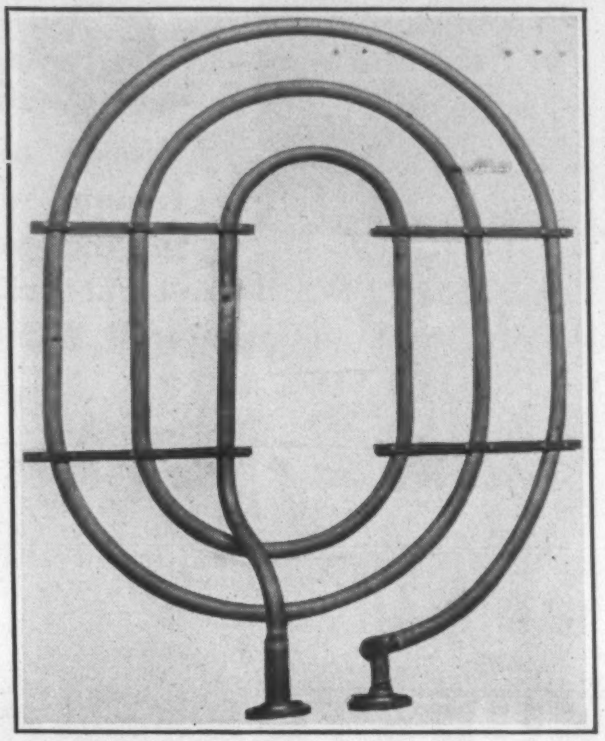

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The rod was Monel Gas Welding Rod #40, 3/32″ dia.

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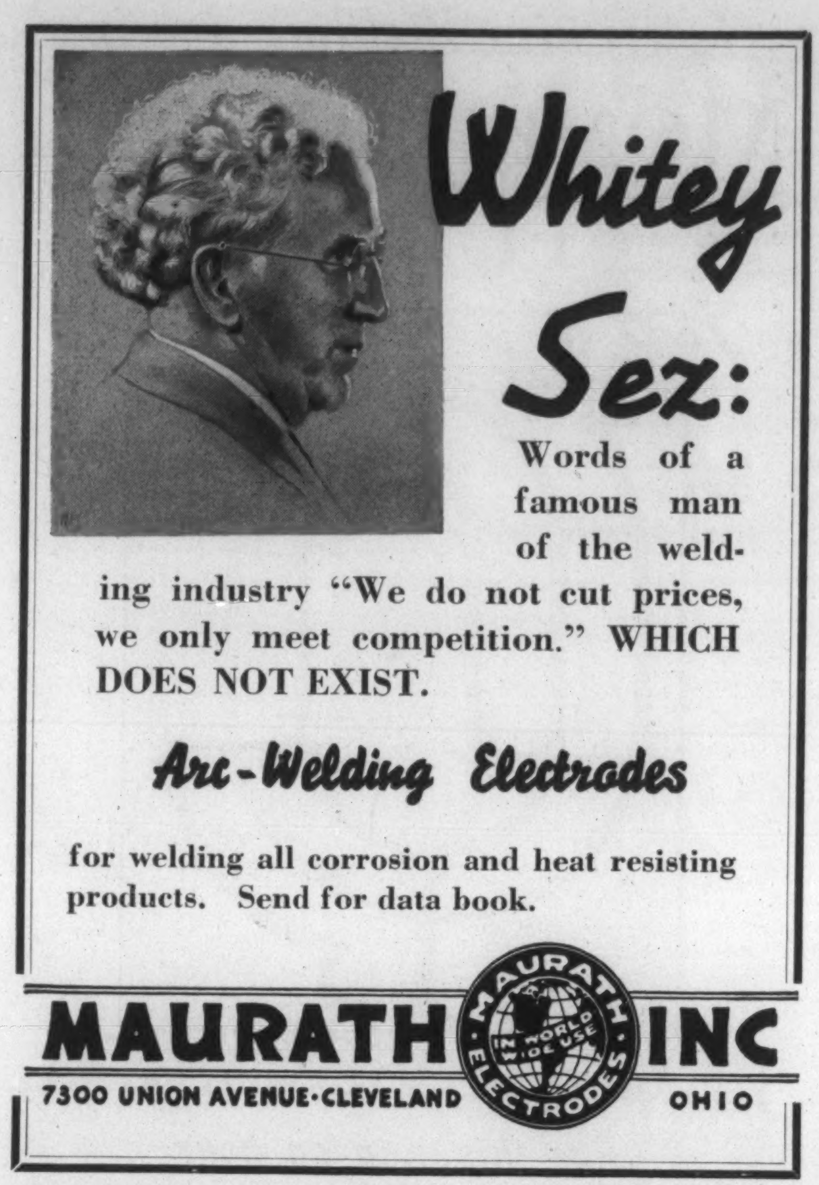

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Requirements for Repairs by Fusion Welding on Boilers and Pressure Vessels. National Board of Boiler Pressure Vessel Inspectors, Columbus, Ohio (approved Oct. 24, 1935). *Welding Journal*, N. Y., Vol. 15, Apr. 1935, pages 31-32. WB (7b)

Welding of Non-Oxidizing Steels (La Chaudronnerie en acier Inoxydable) C. Auribault. *Métaux*, Vol. 10, Dec. 1935, pages 294-296. Welding of 18/8 steels generally requires a heat treatment in order to prevent intercrystalline corrosion. Steels with 13-18% Cr do not offer any difficulty on working. GTM (7b)

Welding in Relation to Automobile and General Repair Work. C. W. Brett. *Gas & Oil Power*, Special Technical Review Number, 1935, pages 10-12. See *Metals & Alloys*, Vol. 7, May 1936, page MA 238R/3. FPP (7b)

Electric Welding. Some Recent Applications to Repair Work. C. W. Brett. *Electrician*, Vol. 116, Apr. 10, 1936, pages 481-482. Application of electric welding to build up worn rails at crossings, repair of faulty riveted joints, boiler welding, bridge repair, and several crank shaft repairs are discussed. Use of coated rods is also discussed. CBJ (7b)

Residual Stresses in Arc-Welded Plates. N. S. Boulton & H. E. Lance-Martin. *Iron & Coal Trades Review*, Vol. 132, May 1, 1936, page 802. Continuous deposition of weld metal along one or both edges of a mild steel plate produced considerable longitudinal residual strains in the plate which were only to a small extent relieved by cutting the weld metal off. About 4/5 of the width of the plate welded along one edge (measured from the unwelded edge) remained practically elastic during and after welding. A study was made of the manner in which the heat penetrated into the plate and of the consequent stress distribution in the plate. A width of about ¾" from the welded edge was, after cooling, stressed in tension to the yield point (17 tons/in.^{2}), and all longitudinal elements within 1.4" of the welded edge were strained, at some time during welding, beyond the elastic limit. Ha (7b)

Sensitivity to Welding Cracks of High Tensile Steels (Schweissrissempfindlichkeit von Stählen höherer Zugfestigkeit) F. Bollenrath & H. Cornelius. *Stahl und Eisen*, Vol. 56, May 14, 1936, pages 565-571. By proper precautions in construction and welding internal stresses formed in welding can be lowered and cracking reduced to a minimum. Uniform heating and cooling is most important. Cracks can form after welding during cooling below 250° C. SE (7b)

Welded Underframes for Freight Cars. Scott D. Baumer. *Metal Progress*, Vol. 29, Mar. 1936, pages 41-43, 88. Describes development of welded gondola freight cars and methods followed in their production in a commercial car shop. WLC (7b)

Resistance Welds Widely Used. George H. Hall. *Electrical World*, Vol. 106, Jan. 18, 1936, pages 32-35, 78. Characteristics of butt, flash, spot projection and seam welding are discussed. Fields for successful application are pointed out. CBJ (7b)

Electric Welding and Its Applications. IX, X. M. Maurice Lebrun. *Welding Journal*, London, Vol. 33, Feb. 1936, pages 38-41; Mar. 1936, pages 70-73. Discusses welding machines and automatic welding. Part X cites rules for successful welding, compares bare and coated rods, and points out advantages and disadvantages of oxy-acetylene and arc welding. WB (7b)

Welded Highway Bridge, Burlington County, New Jersey. W. K. Greene & C. W. Wixom. *Welding Journal*, N. Y., Vol. 15, Apr. 1935, pages 12-16. Mechanical engineering. WB (7b)

Fusion Welding of Bridges. P. G. Lang, Jr. *Welding Journal*, N. Y., Vol. 15, Apr. 1935, pages 16-19. Mechanical engineering phases and general management. WB (7b)

Welding and Cutting High Chromium Steels. W. J. Priestley. *Heat Treating & Forging*, Vol. 22, Feb. 1936, pages 84-86, 97; *Sheet Metal Industries*, Vol. 10, Feb. 1936, pages 169-171; *Iron & Coal Trades Review*, Vol. 132, Apr. 17, 1936, page 716. **Preventing Intergranular Corrosion in Welded 18-8 Chromium-nickel Steels.** *Steel*, Vol. 97, Dec. 2, 1935, page 38. See *Metals & Alloys*, Vol. 7, May 1936, page MA 240R/1. MS + AWM + Ha (7b)

Repair "in situ" of a 200 Ton Press (Reparation sur place d'une presse de 200 tonnes) R. Meslier. *Revue de la Soudure Autogéne*, Vol. 26, Jan. 1936, pages 5-7. Lecture before the Société des Ingénieurs Soudeurs. See *Metals & Alloys*, Vol. 7, May 1936, page MA 242L/1. FR (7b)

Autogenous Welding of Light Metals (Autogenschweissung von Leichtmetallen) M. Maier. *Autogene Metallbearbeitung*, Vol. 29, May 1, 1936, pages 129-134. Difficulties of soft and hard soldering of Al and its alloys are discussed and the advantages of autogenous welding discussed. A suitable flux is necessary in order to destroy the thin oxide film and to obtain a dense, pore-free weld. The acetylene flame must be so adjusted that there is a slight excess of O. The different procedures to be applied for different thicknesses and for castings are described in detail and illustrated by examples. Suitable solders and fluxes are given. Ha (7b)

Oscillograms Assist in Study of Welding Arcs. S. C. Osborne & W. F. Bailey. *Electric Journal*, Vol. 33, Feb. 1936, pages 87-89. Oscillographic study of welding circuit conditions improves the understanding of the electrical characteristics of the welding arc. Method of making the tests is described. CBJ (7b)

Gas Welding of Class 1 Pressure Vessels. G. W. Plinke. *Welding Journal*, N. Y., Vol 15, Apr. 1936, pages 20-24. Report of development of technique and procedure for gas welding with slightly reducing flame to bring ductility of weld in sections heavier than ½" up to standard ductility for Class 1 welds. Progressive hardness tests across double V weld shown in macro and max. for transition zone is 86.5 Rockwell B as against about 70 for parent metal. The impact and ductility values are up to requirements of Class 1 and X-ray shows sound welds. The author recommends the use of oxyacetylene flame in conjunction with arc welds in order to allow bare wire welds with protecting envelope of gas. WB (7b)

Welding as Applied to Heavy Machinery and Marine Engineering. H. N. Pemberton. *Welding Journal*, British, Vol. 33, Mar. 1936, pages 76-85. Review of paper and discussion at Welding Symposium 1935. WB (7b)

Aluminum Welding and Soldering in England and in Germany (Aluminium-Schweissen und -Löten in England und in Deutschland) L. Rostosky. *Aluminium*, Vol. 18, Apr. 1936, pages 143-145. The procedure and methods are compared. They agree to a great extent, but in England, pure Al is welded only with pure Al, while in Germany the welding wires have an addition of Ti. Ha (7b)

Experiments with Spot Welding of Aluminum Alloys (Versuche mit Punktschweissungen an Aluminiumlegierungen) K. Schraivogel. *Aluminium*, Vol. 18, May 1936, pages 177-183. Results from experiments prove that spot welding gives fully satisfactory joints with Al alloys with regard to strength and corrosion resistance. Procedure and equipment are described and suggestions for further development to secure consistently reliable values are made. 9 references. Ha (7b)

Welding in Marine Engine Frames. C. H. Stevens. *Symposium on the Welding of Iron & Steel*, May 2 & 3, 1935, *Iron & Steel Institute*, Vol. 1, pages 599-604. See *Metals & Alloys*, Vol. 7, May 1936, page MA 244L/2. (7b)

Impact Tests of Welded Joints—A Review of the Literature to Jan. 1, 1936. W. Spraragen & G. E. Claussen. *Welding Journal*, N. Y., Vol. 15, Apr. 1936, pages 2-12. Review of practice for German, French, British, Australian welding with respect to specimen, notch and strength standards. The impact test is discussed and effect of various types of notch, specimen size and annealing temperature on impact values are shown. The placement of the notch and its effect on impact value are shown by discussion of research on the subject. Results of impact tests of welds are reported with respect to metallurgical and chemical factors on the impact strength of the welds. Service tests and service results are reviewed. A bibliography on impact testing of welds is appended. WB (7b)

Acetylene Welding of Garden and Agricultural Implements (Azetylenschweissung von Garten- und Feldgeräten) J. J. Thiessen. *Autogene Metallbearbeitung*, Vol. 29, May 1, 1936, pages 135-137. Examples are given. Ha (7b)

Building Oil Well Drilling Equipment by the Use of Arc Welding. C. M. Taylor. *Machinery*, N. Y., Vol. 42, May 1936, pages 582-583. Descriptive. Ha (7b)

Welding of High Tensile Steels (Das Schweissen von Stählen grosser Festigkeit) K. L. Zeyen. *Die Wärme*, Vol. 58, Sept. 1935, pages 616-619. See *Metals & Alloys*, Vol. 7, May 1936, page MA 244L/3. EF (7b)

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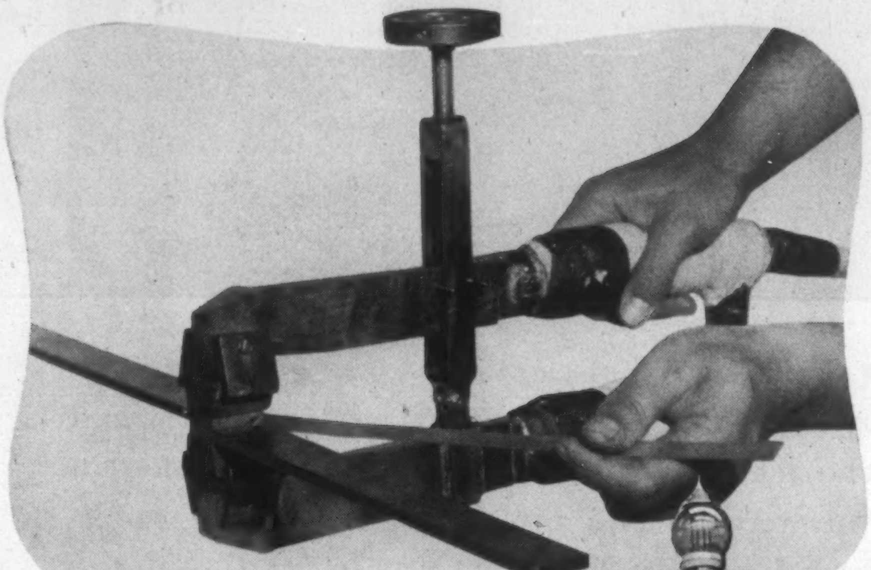

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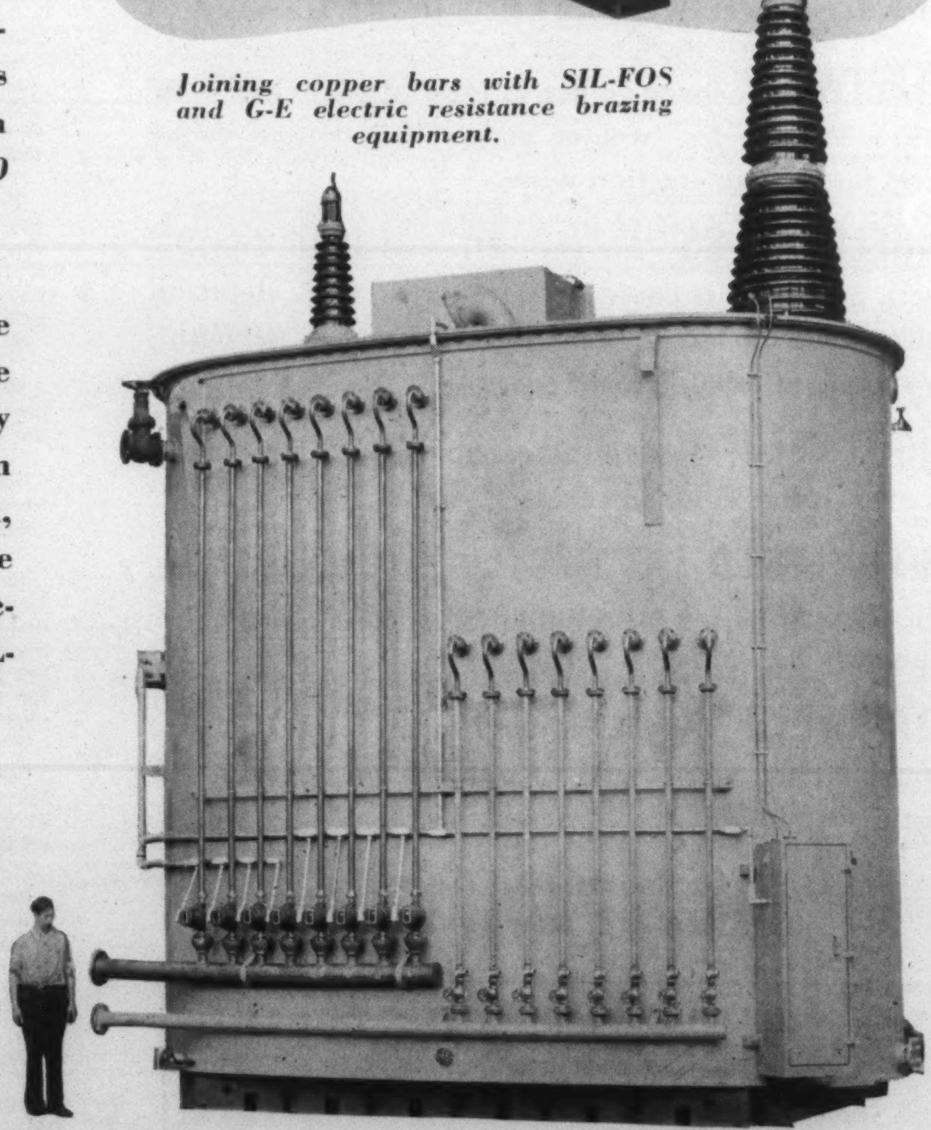

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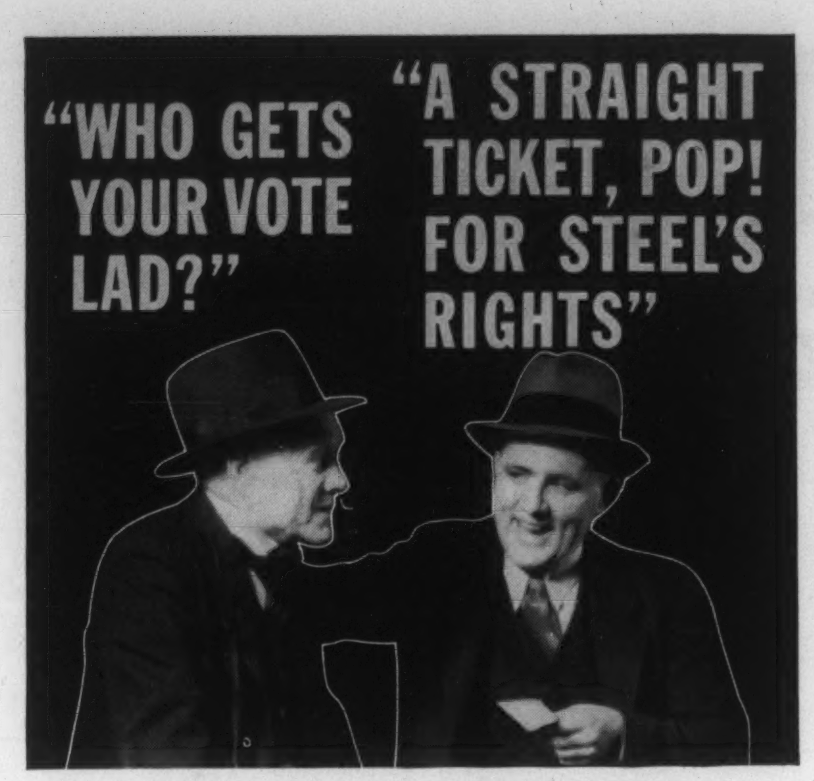
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Present Status of Structural Welding. W. M. WILSON. *Journal Western Society of Engineers,* Vol. 41, Feb. 1936, pages 8-18. A survey purporting to show the extent to which structural welding has been adopted, the reasons, its limitations and the developments whereby its use may be extended and made more satisfactory. Advantages of welding over riveting are: (1) economy, (2) adaptability and (3) flexibility of design. The most serious difficulties encountered in structural welding are: (1) distortions due to welding, (2) thermal stresses, and (3) the low strength of welds subjected to dynamic, repeated, and reversed loads. A machine for fatigue testing of moment-resisting welded joints is described and tests tabulated. WHB (7b)

Prediction of Weld Performance. NAIRNE F. WARD. *Welding Journal,* British, Vol. 33, Jan. 1936, pages 14, 18. See *Metals & Alloys,* Vol. 7, May 1936, page MA 240R/3. WB (7b)

Some Effects of Generator Characteristics on Welding Costs. JOHN H. BLANKENBUEHLER. *Welding Journal,* N. Y., Vol. 14, Sept. 1935, pages 36-38; *Iron Age,* Vol. 137, Jan. 23, 1936, pages 20-22. Discussion of static and transient characteristics of welding machines. Table shows various types of coated and bare electrodes compared as to excellence factors, deposit efficiency, etc., and relative costs are given in terms of lbs. deposited per unit time, unit power, unit weight of electrode purchased. WB + VSP (7b)

Fundamentals of Spot Welding with Particular Reference to Electrode Life. E. I. LARSEN. *Welding Journal,* N. Y., Vol. 15, Apr. 1936, pages 25-31. The important factors in spot welding electrode life are electrical and thermal conductivity, tensile properties and hardness at slightly elevated temperatures, design of electrode, method of cooling of electrode tip, welding pressure and material of which electrode is made. 3 materials were investigated:

Material	Elastic limit lbs./in.^{2}	Ultimate strength lbs./in.^{2}	Rockwell B	% conductivity Cu 100%	Annealing temp. ° F.
Copper (hard)	7,000	35,000	50	98	370
Elkaloy A	45,000	65,000	70	80	660
Mallory 3	50,000	70,000	80	80	1000

The last is shown to be important due to decrease in tip pressure when material flows during use and area of tip is increased thereby. Results of spot tests for the 3 materials are shown for % increase in tip area per thousand spots in welding cold rolled steel, terne plate, stainless steel. The decrease in pressure due to increase of tip area is shown in curves. In all the tests Mallory 3 appears to have longer life than the other metals which is shown by life tests in no. of spots/in. of electrode.

	Copper	Elkaloy A	Mallory 3
No. of spots	489	1362	4590
Material cut away in dressing	.041"	.036"	.024"
Spots/in. of electrode	11,927	37,833	191,250

Some spot welds are discussed which were made under conditions of insufficient heat, proper heat and excessive heat, the micros are shown of the spot. Effect of mushrooming of electrode tip and decreased pressure is shown to be poor bond with no grain growth across the boundary. WB (7b)

Field of Arc Welding Expands. GEORGE H. HALL. *Electrical World,* Vol. 106, Feb. 1, 1936, pages 32-35. Applications of arc welding are usually in construction repair and field work rather than factory production processes. Fabrication of tanks, boiler shells and similar products is done by automatic arc welders. Numerous types of industrial applications of arc welding are discussed. Available methods for arc welding and significant features of different welders are discussed. CBJ (7b)

Resistance Welding of the Copper Alloys. IRA T. HOOK. *Metal Industry,* London, Vol. 47, Dec. 13, 1935, pages 586-590, 595. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 190R/9. HBG (7b)

Methods of Minimising Distortion in Welding Light Gauge Steel. J. H. BLAHA. *Sheet Metal Industries,* Vol. 10, Jan. 1936, pages 57-58, 60. See *Metals & Alloys,* Vol. 7, May 1936, page MA 240L/4. AWM (7b)

How Flexible are Long Rails? *Railway Engineering & Maintenance,* Vol. 32, Feb. 1936, pages 82-85. The Delaware and Hudson railroad has found it practical, in making a third installation of continuous rails in more than one mile lengths, to weld 20 rails together on flat cars before laying. No difficulties were met in moving welded rails over sharp curves or in handling them into the track. The time required for welding was cut in half by the method. Details of welds, organization methods, transport, handling, etc. are described. FPP (7b)

Shape-Cut Locomotive Parts. G. B. MOYNAHAN. *Welding Journal,* N. Y., Vol. 15, May 1936, pages 28-29. Use of flame-cutting and bending to shape after cutting is shown to eliminate complicated and expensive forgings. Flame cutting machine was arranged to cut in 2 planes at right angles. WB (7b)

Reclaiming Manganese Equipment with Nickel-Manganese Steel. B. H. PAYNE. *Pit & Quarry,* Vol. 28, May 1936, pages 60-62. The history of Mn steel and its castings is reviewed. The welding of Mn steel with Ni-Mn is described. AHE (7b)

Progress of Fusion Welding. ALBERT PORTEVIN. *Metal Progress,* Vol. 30, July 1936, pages 59-60. Description of welding methods, technique and applications in France. WLC (7b)

NEMA Offers New Standards to Arc Welding Field. A. LESLIE PFEIL. *Welding Engineer,* Vol. 21, May 1936, page 44-46. Standardization as projected by National Electrical Manufacturers Association is reviewed. Ratings of a.c. generators, temperature rise, current and voltage ratings of a.c. transformer arc welders. WB (7b)

The Welding of Herculoy. R. STEINMETZ. *Welding Engineer,* Vol. 21, Apr. 1936, pages 28-31. Material can be welded by arc, gas or resistance methods. Details are given for successful welding of the material for various gages of sheet and various methods of welding. Tabular data presented for carbon arc, oxyacetylene, metallic arc and stitch welding. WB (7b)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Inferior Base Material as the Cause of Defective Coatings of Zinc and Enamel on Steel Sheet (Mangelhafter Kernwerkstoff als Ursache fehlerhafter Überzüge auf verzinkten und emaillierten Stahlblechen) HANS FROMM. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* No. 11, 1934, pages 10-24. Discusses conditions of steel sheet that cause defects in enamel, Zn, Sn, and Pb coatings. Steel sheet to be pickled and coated should be selected in accordance with the following requirements: Only killed steel should be used. Owing to tendency to segregate, the sum of P and S should not exceed 0.06%. Steel that will coat properly should be selected by the maker rather than by the buyer on the basis of analysis. The ingots should be rolled at a temperature high enough to weld sub-surface blowholes. For ingots with pronounced top segregation or deep pipe, the top discard should be at least ⅓ of the ingot weight. The final pass in rolling should give a reduction of 5 to 8% and the sheet should be as cold as possible for this pass. During rolling, scale should be removed by water at high pressure. The surface of the sheet should be scaled as little as possible and local heating should be avoided. If the annealing temperature in box annealing is not high, critical reduction in rolling should be avoided. The C should not be under 0.05% and all carbide should occur as pearlite, not as grain-boundary cementite. JLG (8)

8a. Pickling

Notes on the Efficient Pickling of Iron and Steel. C. H. MCCOLLAM & D. L. WARRICK. *Metal Progress,* Vol. 29, May 1936, pages 61-67. Notes on acid used and inhibitors and technique recommended for economical pickling in 1936 edition, National Metals Handbook. WLC (8a)

8b. Cleaning including Sand Blasting

Cleaning Billet Surfaces with Oxy-Acetylene Flame. ERNEST E. THUM. *Metal Progress,* Vol. 29, May 1936, pages 35-38. Billet cleaning for seamless tubing production was investigated by dividing 75 ton heat into 3 equal parts; chipping gave a loss of 500 lb. of metal and cost \$2.50/ton; using a planer or gouging machine gave a metal loss of 1500 lb. and cost \$1.25/ton; and with acetylene flame metal loss was 900 lb. and cost \$1.00/ton. Billets are first pickled in concrete tanks lined with paving bricks set in molten S. 200 tons of billets may be pickled in 2 hrs. at a cost of \$0.15-0.20/ton. Torch used and technique of defect removal with it are described. WLC (8b)

8c. Polishing & Grinding

The Polishing of Metals. E. J. DOBBS. *Aluminium & Non-Ferrous Review,* Vol. 1, Mar. 1936, pages 184-186. Paper before the Midland Metallurgical Societies, with discussion. Polishing operations before and after electro-plating are described. Solid felt "bobs" dressed with emery of different grades are generally used first and are followed by polishing "mops" dressed with tripoli, rouge, alumina, lime, crocus, or chromium oxide for the final operation of "colouring" before plating. Similar mops are also used for "finishing" after plating. JCC (8c)

Ribbon-, Disc- and Drum-grinding Machines in the Metal Industry (Band-, Teller- und Trommelschleifmaschinen in der Metallindustrie) F. FACHTNER. *Oberflächentechnik,* Vol. 13, May 5, 1936, pages 103-104. Various types of grinding machines are described and their field of application according to purpose and material defined. Average velocities of grinding are for Pb 12-15 m./sec., cast Fe 28 m./sec., Al alloys lower or higher than 28 m./sec. Details of construction are given. Ha (8c)

Barrel Burnishing. WALTER R. MEYER. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, pages 318-319. Abbreviated translation from *Oberflächentechnik.* See *Metals & Alloys,* Vol. 7, June 1936, page MA 302R/6. JCC (8c)

Abrasives Used in the Polishing and Buffing of Metals. A Correlated Abstract. I, II, III. R. S. LEATHER. *Platers' Guide,* Vol. 32, Apr. 1936, pages 15-17; May 1936, pages 24-25, 28; June 1936, pages 16-18. Digest of recent literature on the subject. Differences between polishing and buffing abrasives are outlined. The abrasive action on metals is discussed and a comparison made between fused Al_2O_3 and Turkish emery. The use of silicate of soda as a binder for holding the abrasive to the set-up wheels is increasing. A single coat of abrasive is more economical than a double coat. The value of emery depends upon the amount of crystalline Al_2O_3 contained. The efficiency of a polishing medium as expressed by the metal removed is compared with abrasive material. Capillarity test, exact sizing and uniform shape of grains, artificial vs. natural abrasives, treated grain and physical properties of the abrasive on which depends ability to cut a metal surface are considered. WHB (8c)

Finishing of Manganese Steel Parts by Grinding. FRED B. JACOBS. *Iron Age,* Vol. 137, Mar. 12, 1936, pages 46-50. Describes procedure of Marion Steam Shovel Co., where steam shovel parts are made of Mn steel because it resists abrasive action and at the same time possesses high tensile strength. VSP (8c)

8d. Electroplating

Concentrated Copper Cyanide Baths. L. C. PAN. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Nov. 8, 1935, pages 471-474. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 454L/10. HBG (8d)

Nickel Plating and Chromium Plating of Aluminum and Aluminum Alloys (Die Vernicklung und Verchromung von Aluminium und Aluminiumlegierungen) E. RAUB. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 9, Feb.-Mar. 1936, pages 111-121. Plating of Al or its alloys with Ni or Cr is possible only after the natural oxide film has been thoroughly removed. The various methods developed with more or less success during the last 30 years are reviewed and the methods most widely used discussed. The most successful are the method of Ballay, with Fe chloride, and that of Altmannsberger, with zincate. Fischer (DRP 606,850 and 611,643) oxidizes the Al at first electrolytically and treats it afterwards cathodically in a degreasing bath containing heavy metals, e.g. Cu and Zn, whereby a thin film of the heavy metal is deposited on Al which makes it respond to treatment in the usual plating baths. A pore-free, dense deposit is obtained only on a pore-free, dense basis. The porosity of Ni deposits and corrosive attack were investigated under different conditions and the adhesion and ductility of the deposits determined. The greater the initial surface roughening before plating, the better was the adhesion and resistance against corrosion of the coating. A pore-free, corrosion-resistant coating of Ni on Al must have a thickness of at least 0.02-0.03 mm., which is about the same as for Fe. After being highly polished the Ni deposit can still be Cr plated which gives an excellent corrosion resistance even on material which is bent 90° and 180°. Ha (8d)

Pictorial Study of Plating Conditions. W. M. PHILLIPS. *Monthly Review, American Electroplaters' Society,* Apr. 1935, pages 21-31. A small glass electrolytic cell is placed in a projector and the effects of the current in passing from anode to cathode through the solution can be projected on the screen. Dissolving of the anode, color changes in the solution, pitting of the deposit, and other effects are studied visually. GBH (8d)

Contribution to the Study of Nickel Plating Duralumin (Contribution à l'Étude du Nickelage du Duralumin) E. DECARRIERE & A. HACHE. *Chimie et Industrie,* Vol. 33, May. 1935, pages 595-596. Conclusion of a series of researches in which the author has studied the action of cementation, electrolysis, and use of Sb as an auxiliary metal to obtain a Ni plate. MAB (8d)

Glossy, Gray and Black Chromium Plating (Glanzchrom-, Grauchrom- Schwarzchrom) A. WEISS. *Oberflächentechnik,* Vol. 13, May 5, 1936, pages 101-102. Glossy, bright Cr deposits can be obtained only within a certain range of current density which depends on the cathode material and particularly on the temperature. For previously Ni plated parts, this lies between 5 and 15 amp./dm.^{2}, for 40° C. and between 12 and 30 amp./dm.^{2}, for 50° C. Above this, gray (burnt) deposits are obtained. Very high current densities produce very hard, gray layers which contain about 1000 times their volume of H. No Cr oxides are found. Black deposits are obtained with 100-150 amp./dm.^{2} density. Very deep black deposits are produced if acetic acid or any other organic acid is used instead of H_2SO_4. The voltage for the bath must be 11-14 volts as the currents are about 10 times as high as in bright Cr plating. The strong H evolution requires an exhaustor and the temperature must be kept below 15° C. Direct black Cr plating is not to be recommended as it takes too long a time and is therefore costly. It is best to Ni plate first, then bright Cr plate and finally black Cr plate for a very short time, about 1 min. Black Cr plating is advantageously applied where formerly black Ni plating or black lacquer was employed; although more costly black Cr deposits have a higher mechanical and chemical resistance. DRP application 110226 covers a "bright-gray-black Cr plating process." 11 references. Ha (8d)

Electrogalvanizing of Round Wire. A. WEISSELBERG. *Wire & Wire Products,* Vol. 11, June 1936, pages 281-285, 290. Existing processes for electro galvanizing are reviewed and critically compared with hot galvanizing. Operating advantages are (1) maximum Zn economy as there are no Zn losses, (2) no losses during shut-downs, (3) accurate control of the thickness of the coating, and (4) clean and sanitary condition of the plant. The coating is very uniform and a thickness of 0.2 oz./ft.^{2} can be obtained in one run. Physical properties of the wire are not affected by the electrolytic process as they are in hot galvanizing, particularly for C spring steels. The coating of pure Zn is highly ductile and adheres perfectly, is smooth and easily shows up defects of the wire. The cost/ton galvanized wire is given as \$9.70 for 0.6 oz./ft.^{2} coating and \$13.15 for 1 oz./ft.^{2} Ha (8d)

Electrolytic Deposition of Bivalent Europium (Die elektrolytische Abscheidung des zweiwertigen Europiums) A. BRUKL. *Angewandte Chemie,* Vol. 49, Feb. 29, 1936, pages 159-161. Difficulties in depositing the rare-earth metals are briefly explained and a method described which permits an easy separation of Eu from accompanying elements on Hg cathodes. An addition of isomorphous Sr sulphate makes possible the deposition from solutions with even less than 2% Eu_2O_3. Ha (8d)

Electrolytic Plating of Aluminum in Fused Salt Solutions. S. I. ORLOVA & V. I. LAINER. *Legkie Metallui,* Vol. 4, Dec. 1935, pages 9-16. In Russian. Best results are obtained by using a chloride solution with a molecular ratio of $AlCl_3$: NaCl of 2:1 and a current density of 0.2 to 0.5 amp./dm.^{2} at a temperature of 120° C. The $AlCl_3$ in the electrolyte is volatile and inferior results are obtained as its concentration decreases. The addition of 0.2% $PbCl_2$ to the electrolyte improves the coating. HWR (8d)

The Electrolytic Deposition of Alloys (Deposits electroliticos de aleaciones) J. IBARZ. *Metalurgia y Construccion Mecanica,* Vol. 2, June 1936, page 2. Discusses the electrochemical processes which make possible the electrodeposition of metals or alloys. FRM (8d)

Durability of Plated Steel Exposed to Weather. WILLIAM BLUM. *Metal Progress,* Vol. 29, Feb. 1936, pages 40-41. Results of exposure tests and several methods of measuring coating thickness are briefly described. Results of these tests by the Bureau of Standards in coöperation with A.S.T.M. and American Electroplaters' Society have established certain essential requirements. For Zn and Cd: (a) general service, minimum thickness 0.0005", (b) mild service, minimum thickness 0.00075". For Ni and Cr (a) general service, minimum thickness of Cu + Ni 0.00075" with at least 0.0004" Ni and average Cr thickness of 0.00002", if required, plate to withstand 48 hrs. continuous salt spray, (b) mild service, minimum Cu + Ni 0.0004", at least ½ of which is Ni, and Cr, where required, 0.00002", plate to withstand 16 hrs. salt spray test. WLC (8d)

A Study of Al-Hg-Zn Anodes in Acid Zinc Plating Baths. A. K. GRAHAM & P. G. KOLUPAEV. *Metals & Alloys,* Vol. 7, Jan. 1936, pages 14-17. Best bath consists of $ZnSO_4.7H_2O$ 32 oz./gal., $Al_2(SO_4)_3.18H_2O$ 4 oz./gal., NH_4Cl 2 oz./gal., pH 4. Operation at 32-42° C. (90-108° F.) with anode current density 20-100 amp./ft.^{2} and cathode current density below 45 amp./ft.^{2} results in anode efficiency of 99%, polarization under 0.2 volt, bath free from sludge, and a satisfactory adherent deposit. With bath voltage about 2.0 volts and current density of 45 amp./ft.^{2} the change in pH is negligible. Plain Zn anodes result in sludging of the bath. WLC (8d)

The Role of Films in the Electrodeposition of Metals. A Correlated Abstract. WALTER R. MEYER. *Metals & Alloys,* Vol. 7, May 1936, pages 123-126; June 1936, pages 155-159. Classifies films as (1) preferential-solution films consisting of a smudge of undissolved material as C or carbides on pickled steel or Fe left by the cleaning solution, (2) deposited films of dirt, grease or smuts and absorbed colloid, (3) passive films and (4) polishing films. These various films are discussed as to manner of formation, effects upon adherence of deposit and remedies applied to different materials. Influence of basis metal structure on that of deposit is discussed. The role of films formed intentionally on plated deposits or unplated metals for effecting surface protection is discussed. 153 references. WLC (8d)

Improvement in the Quality of Tinplate by Superimposed Electrodeposition of Tin. A. W. HOTHERSALL & W. N. BRADSHAW. *Sheet Metal Industries,* Vol. 10, Jan. 1936, pages 15-18; Feb. 1936, pages 139-140. **Closure of Pores in Tinplate by Electrodeposition.** *Metal Progress,* Vol. 29, Jan. 1936, page 39. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 499L/1. AWM + WLC (8d)

Iron in the Chromium Bath and Its Precipitation (Das Eisen im Chrombade und seine Ausfällung) E. RAUB. *Mitteilungen der Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 10, Apr. 1936, pages 1-7. The harmful presence of Fe in Cr plating baths, its origin and chemical reactions are explained, and means for removing it by electrolytic precipitation were investigated. The harmful effect becomes noticeable at 5% Fe in the bath (referred to chromic acid) and increases with increasing Fe content, with 10% Fe, however, Cr-plating is still possible. From baths very rich in Fe (dull gray) Cr deposits contaminated with Fe are produced. The precipitation of the Fe is feasible but is a very tedious process which is profitable only for large volumes of bath solutions. It is more advisable to prevent accumulation of Fe by proper working conditions and supervision. This can be done as the sources of contamination of the Cr bath are known and, therefore, can be prevented. Ha (8d)

The Electrodeposition of Bronze Using Bronze Anodes. S. BAIER & D. J. MACNAUGHTAN. *Technical Publications of the International Tin Research & Development Council,* Series A, No. 27, 1936, 14 pages; *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 47, Nov. 29, 1935, pages 543-546; Dec. 6, 1935, pages 567-570. Paper read before the Electrodepositors' Technical Society at Northampton Polytechnic Inst., Clerkenwell, London, Oct. 30, 1935. The paper describes some of the results obtained as a part of a series of investigations planned by the International Tin Research & Development Council. In preliminary work it was found that Ni or Cu, added to a stannate solution as complex cyanides, could be co-deposited with Sn. Extension of the work (by Bechard) to the deposition of Cu-rich Sn-Cu alloys (bronzes) from baths rich in Cu established the superiority of this type of bath over the oxalate bath used in earlier investigations. In this paper are reported the results obtained with a bath of this type. The anodes were cast bronze rods containing 12% Sn, annealed 1 hr. at 700° C. The solution used had the following composition;

commercial copper cyanide	150 g./liter,
" sodium stannate	50 g./liter,
sodium cyanide	15 g./liter.

The solution was kept at 65° C. during deposition. Data for anode and cathode efficiency are reported graphically, the method of obtaining these data described, and the method of balancing these efficiencies indicated. The hot water porosity tests used are described and data obtained on throwing power of the solution are given. It is suggested that the excellent throwing power of the bronze solution may be explained by the pronounced fall of cathode efficiency with increase in current density. Comparative tests were made of Cr plating of steel specimens previously coated with bronze and Ni. When tested for porosity in hot water the Cr plate on bronze was equal to, and in some instances superior to, the plating on Ni. It is stated that the Brinell hardness of electrodeposited bronze is harder than annealed bronze and comparable to that of hard Ni deposits. The method of analysis of electrodeposits of bronze on steel is indicated. The article is illustrated. 16 references. HBG (8d)

Electrodeposition in Dentistry—Application to Inlay Dies. J. A. VIVERITO & JOHN DAMIANO. *Dental Cosmos,* Vol. 22, Nov. 1935, pages 1202-1210. Detailed directions are given for producing Cu shell dies for inlays. The surface of the wax model is made conducting by the application of metal powder (Cu), after which the Cu shell is deposited from a sulphate bath by using a current density of about 60 amps./cm.^{2} After backing the shell with low-fusing alloy, stone, or plaster, it is ready for use. The procedure has other applications, and other metals can be deposited with the equipment. 5 references. OEH (8d)

The Adhesion of Electrodeposits. W. R. MEYER. *Monthly Review American Electroplaters' Society,* Vol. 23, Feb. 1936, pages 5-37. The force responsible for adhesion decreases rapidly (as the 4th power) as the interatomic distance increases and becomes very small at a distance as large as .0000002". This illustrates how even traces of oxide or grease films may cause peeling. Cleaning: Metal treated in an alkaline cleaner and showing no water-breaks may nevertheless be a source of peeling from (1) hydrogen embrittlement, (2) plating action of an electric cleaner, (3) presence of hydrophylic colloids such as albumin, peptone, glue, gelatine. Pickling: Acid dipping with or without current removes oxides, and cold worked surfaces and neutralizes alkaline films remaining from the cleaner. Smut resulting from undissolved constituents, as C in steel, Cu and Si in Al alloys, Cu in Zn alloys, can be avoided by selecting proper time. Temperature and concentration of acid. Rinsing: Since alkali cyanide solutions are viscous their rinsing action is slow. Acid dips should precede acid plating solutions, cyanide dips precede cyanide solutions. Plating conditions: The alkaline film which forms adjacent to cathode surface will cause formation and codeposition of hydroxides which in turn may cause hard brittle peeling deposits. Peeling may also be caused by high current density. Properties of deposit which may cause peeling are inherent stresses (Ni and Cr have high contractive tendency) and coefficient of expansion. Latter usually causes cracking rather than peeling. Thus coefficient of expansion of Zn is 4 times that of Cr and this is probable explanation of cracking of Cr direct on Zn. Diffusion of electrodeposits into basis metal occurs for Au on Pb, Cu on Al and Zn, Cd on Cu or Fe. When the alloy resulting from diffusion is brittle (as Cu on Zn) peeling results. Among the illustrations is a diagram of polished Cu showing a surface layer of amorphous metal .0000004" thick. Under this, a layer of small crystals .0002" thick, under this a transition zone .001" thick, finally the undeformed basis metal. Photomicrographs show; precipitation of Sb from solid solution in a Pb-Sb alloy, minute holes and skin on surface of a die casting, cracking of Ni deposit on Zn, hot galvanized coatings showing alloy zones, diffusion zones of Cu on Zn, distribution of deposited metals around undercuts in basis metal, and cracks in Ni deposit transmitted to Pb-Sb alloy basis metal. GBH (8d)

Modern Equipment for Ni- and Cr-plating (Organisation Moderne d'un atelier de nickelage et de chrome) J. LOISEAU. *Métaux,* Vol. 11, Feb. 1936, pages 24-30. General description of Ni and Cr plating plant at Fonderies Arthur Martin at Revin, France. Ni plating takes 12 minutes with a current density of 20 amp./dm.^{2}, for a coating 20 microns thick. Cr plating takes 5 minutes. GTM (8d)

Bronze Electrodeposits. C. BECHARD. *Metal Progress,* Vol. 29, Mar. 1936, pages 43, 94. See "The Electrodeposition of Bronze Using Bi-metallic Anodes," *Metals & Alloys,* Vol. 7, June 1936, page MA 304L/2. WLC (8d)

8e. Metallic Coatings other than Electroplating

An Electrolytic Test for Zinc Coatings on Wire. S. C. BRITTON. *Journal Institute of Metals,* Vol. 58, Jan. 1936, pages 49-60 (Advance Copy No. 724). Two tests are proposed: one an electrolytic stripping test and the other a wrapping test followed by stripping. In the stripping test the wire is made the cathode of a special cell, and a fixed current passed through the cell for a specified time, after which the sample is dipped in $CuSO_4$. If no red Cu is precipitated on the specimen, Zn coating has not been completely removed to the Fe at any spot and the wire is considered to meet the requirements. In the other test the wire is wrapped around a cylinder, the diameter of which depends on the use to which the wire is to be put, straightened, and then handled as in the other test. This test gives an indication of the brittleness of the coating. Structures of different coatings were determined by measuring voltage in cell at intervals as stripping proceeds. Voltage-time curves give an indication of the thickness of the Zn and Fe-Zn layers. Different types of curves are obtained for hot-dipped, electrolytic and galvannealed coatings. 11 references. JLG (8e)

Metallic Cementation by Means of Manganese Powder. TSUTOMU KASE. *Kinzoku no Kenkyu,* Vol. 12, Oct. 1935, pages 478-483. In Japanese. The diffusion of Mn, in the form of pulverized commercial product, into Fe, Ni, and Cu, at various temperatures between 600°-1100° C. for 1, 2, 3, and 5 hours was investigated. The hardness of the surface layer of the cemented specimens and the depth of penetration were measured together with microscopic examination, chemical analyses, and corrosion tests with various concentrated acids. It was found that Mn diffuses into the metals mentioned at temperatures above 600°, the rate of diffusion increasing with increase of temperature. In the case of Fe, the rate increases very abruptly at the A_3 point, (906° C). The relation between the weight increase of the specimen and the absolute temperature of the cementation or the duration of the treatment is given by the following exponential function,

$$W = ae^{-b/T}$$

where W is the increase of weight of specimen,
T, absolute temperature of heat treatment,
a, b, constants.

The surfaces of Fe and Ni cemented with Mn are easily attacked by concentrated acids, while that of Cu is unaffected by corrosion with dilute H_2SO_4, HCl or concentrated HCl. KT (8e)

Cementation of Some Metals by Means of Ferro-titanium Powder. TSUTOMU KASE. *Kinzoku no Kenkyu,* Vol. 13, Feb. 1936, pages 50-60. In Japanese. By means of pulverized ferrotitanium the cementation of Ti into Fe, Ni, Cu at various temperatures between 800° and 1300° C. was investigated. The depth of penetration was measured; microscopic examination and chemical analysis were carried out and resistance to corrosion against some acids studied. The following facts were found: Ti diffuses into the metals above mentioned at temperatures above 800° C., the rate of diffusion increasing with rise of temperature. The rate of diffusion into Fe, however, increases very abruptly at the A_3 point (906°). The relation between the weight increase of the specimen (Δ W) or the depth of penetration (P) and the absolute temperature of cementation (T) or the time (Θ) required for the treatment is given by an exponential function ΔW (or $P) = ae^{-b/T}$, where a and b are different constants in each case. Although the cemented surfaces are harder than the original material, they give little promise with regard to corrosion resistance. KT (8e)

New Processes in the Manufacture of Bearing Bushings with Copper-Lead Lining (Neuere Verfahren bei der Herstellung von Lagerkörpern mit Kupfer-Blei Auskleidung) KURT NISCHK. *Giesserei*, Vol. 23, Jan. 3, 1936, pages 4-7. It is difficult to make Cu-Pb mixtures adhere firmly to the material of the bushing and to prevent segregation of Pb when cooling slowly. To eliminate these inconveniences direct casting of the lining alloy on the bushing has been tried and also casting the alloy on a sheet which is then formed as a bushing. Several patented methods (French No. 714180, 680049, 785351, British No. 413932, 416371, American No. 1870867, 1956466) are discussed and described. Ha (8e)

Reactions of Iron with Molten Zinc (Ueber die Reaktionen des Eisens mit flüssigem Zink) W. PÜNGEL, E. SCHEIL & R. STENKHOFF. *Archiv für das Eisenhüttenwesen*, Vol. 9, Dec. 1935, pages 301-304. The attack of Fe by molten Zn is much stronger when $FeZn_7$ instead of $FeZn_3$ is formed. The formation of $FeZn_3$ serves to protect the Fe from further attack. No obvious relationship appeared between the composition of the steel and the Zn both and the tendency to form $FeZn_3$. SE (8e)

Sprayed Metal Coatings. Technique and Properties. E. L. MATHY. *Metal Progress*, Vol. 29, Apr. 1936, pages 52-56. Describes "metallizer gun" for spraying molten metal from wire feed into an oxyacetylene flame. The molten metal is forced out by compressed air. The particles of metal flatten on impact with surface to be coated. Any oxide film is broken and the formation of a true weld is claimed. These particles overlap each other and form a coating similar in structure to the scale of fish. Preparation of the surface is important to good coating. Costs and properties of various coatings are given. WLC (8e)

Aluminum Plating. *Metal Industry*, London, Vol. 47, Dec. 6, 1935, page 570. Resume of article by H. G. Heine in *Aluminium*, Sept. 1935. See *Metals & Alloys*, Vol. 7, Mar. 1936, page MA 136R/4. HBG (8e)

Methods of Detinning Tinplate for Examination of the Thickness and Continuity of the Alloy Layer. A. W. HOTHERSALL & W. N. BRADSHAW. *Iron & Steel Institute*, Advance Copy No. 10, May 1936, 10 pages; *Technical Publication of the International Tin Research & Development Council*, Series A, No. 37, 1936, 10 pages. The Sn layer can be removed, without attacking the alloy layer, by dissolving in Na plumbite or by an anodic treatment. The former involves immersion in the boiling solution for 3 to 5 min. Electrolytic treatment consists in treating in 5% NaOH at 30° C. The potential difference should be controlled and should not exceed 1 volt. From 10 to 20 min. is required for detinning an average sample. Weights of alloy found on several tin-plate sheets are listed. An average of 3.3 oz. of alloyed Sn per base box was found on tin plate carrying 2 lb. or less Sn per base box. Larger amounts of alloyed Sn were found with heavier coatings, the maximum being 1 lb. 1.2 oz. of alloyed Sn per base box. The alloyed layer was found to be highly porous. JLG (8e)

A Study of the Origin of Porosity in the Tin Coating of Tinplate. A. W. HOTHERSALL & J. C. PRYTHERCH. *Iron & Steel Institute*, Advance Copy No. 11, May 1936, 15 pages; *Technical Publication of the International Tin Research & Development Council*, Series A, No. 38, 1936, 15 pages. Tin plate of various grades was examined with a view to correlating position of pores in the Sn coating with visual imperfections or peculiarities of the tin plate. Pores were located by slight rusting of the plate in distilled water. Their position was marked and the rust removed by a brief cathodic treatment in alkali. The plate was then examined microscopically. In finished plate, from 30 to 50% of the pores were found in scratches produced in the final cleaning and polishing. Plate with less than 2 lb. of Sn per base box had scruff lines (crystals of Fe-Sn alloy) at right angles to the direction of travel of plate through tinning bath. In plate that had not passed through the cleaning or polishing rolls, pores were chiefly located in the scruff bands and grease marks. Scruff bands were not seen in plate with more than 3 lb. of Sn per base box but the largest grease marks of saucer shape were grouped in periodic bands at right angles to the direction of tinning. Practically all of the pores not associated with scratches were located in these bands. Discontinuities in the Sn coating could be seen under the microscope at the site of the pores. The alloy layer left after solution of Sn was found to be highly porous. Porosity could be increased by slight stretching. JLG (8e)

■ 8f. Non-Metallic Coatings ■

Synthetics for Automotive Finishing in U. S. A. HERBERT CHASE. *Synthetic & Applied Finishes*, Vol. 6, Nov 1935, pages 196-197, 200. Synthetic enamels have long been preferable to lacquers for running gear and other chassis parts, and recently have displaced nitrocellulose lacquers in finishing passenger car bodies. Modern "straight synthetics" dry free of dust in 2 hours without baking. Usually an overnight drying is allowed, except for 2-coat jobs, when the second coat is sprayed on after the 1st has dried ½ hour, and both coats allowed to dry overnight. Variations in application are described and advantages of synthetic enamel over lacquer for automotive finishing are cited. FPP (8f)

Investigations of Phosphate Protection for Ferrous Metals (Richerche sui bagni di protezione fosfatica per metalli ferrosi) O. MACCHIA. *Industria Meccanica*, Vol. 18, Feb. 1936, pages 81-85; Mar. 1936, pages 141-143. The principal baths used for producing phosphatic protection of ferrous metals are reviewed and described in detail, and patents and patented processes cited. 70 references. Ha (8f)

Pretreatment of the Base for Coats of Paint (Vorbehandlung des Untergrundes für den Anstrich) FR. KAPPLER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 80, Feb. 15, 1936, pages 183-185. The adhesion of paint depends to a great extent on the initial treatment of the base: The adhesion of paint was measured on surfaces cleaned by grinding, brushing with steel brush, and sand blasting of different degrees. In general, cleaning with the brush is sufficient for ordinary structures to be protected against weathering, but bridges, weirs, etc. should be sand blasted before painting. Pickling should be applied only for single pieces and where subsequent cold working is required; it should not be employed in composite pieces as the pickling liquid enters the interstices. Ha (8f)

Rapid and Economic De-enameling Process (Procédé rapide et économique de Désémaillage) J. NAPPEE. *Usine*, Vol. 45, Mar. 12, 1936, pages 29-30. Difficulties of de-enameling and current methods used are discussed; the latter were not very economical. A new method and equipment are described which do not attack the base; caustic soda is at first heated to 530°-550° C. to free it from its water of crystallization. Such a bath dissolves enamel dipped into it in about 45 sec. and no harmful gases are developed although slight sputtering takes place against which the workmen must be protected. The de-enameled pieces are rinsed in cold water. The process is said to be cheaper than dissolving in acid or removal of the enamel by sand blasting. Ha (8f)

Anodic Oxidation. J. W. RUSHTON. *Aluminium & Non-Ferrous Review*, Vol. 1, May 1936, pages 380-381. Brief notes on applications of the process. JCC (8f)

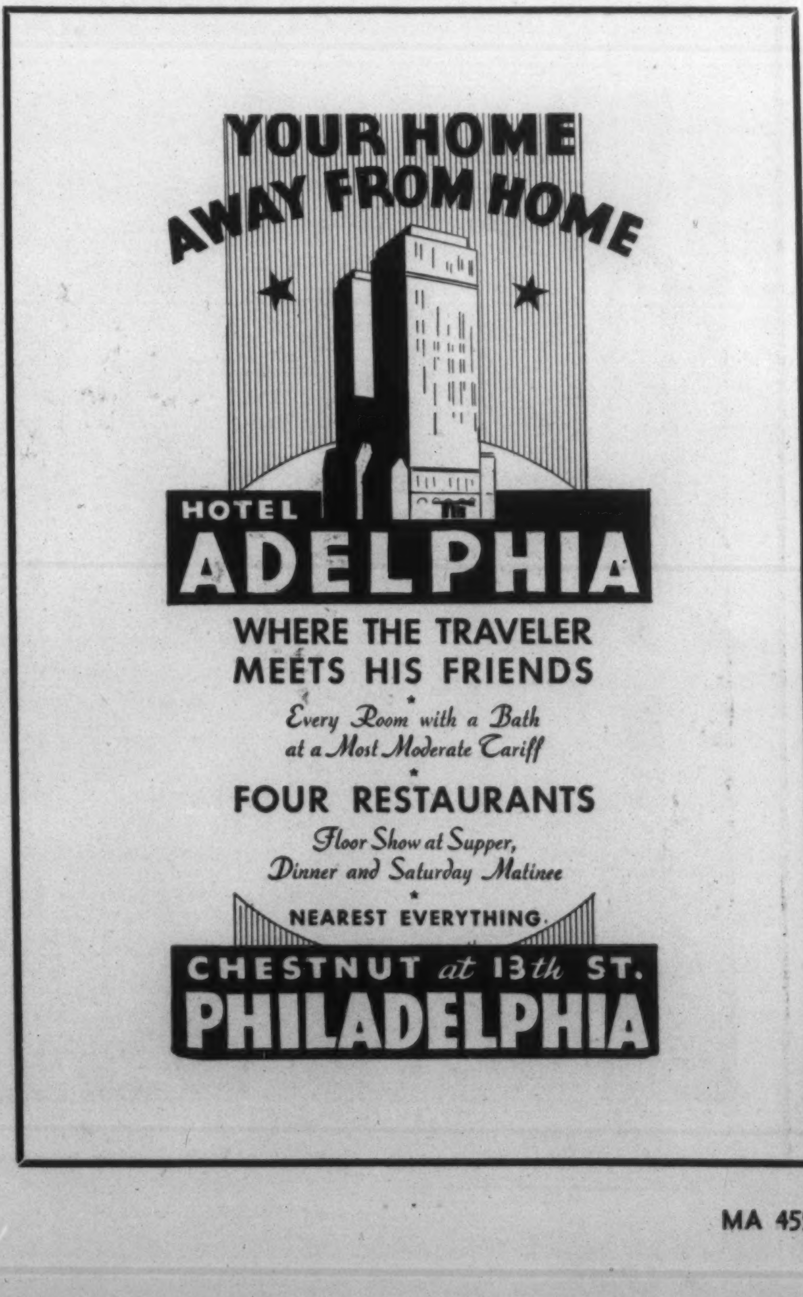
Iron Black and Iron Hammer Scale as Pigments for Antirust Paint (Les Noirs de Fer et l'Oxyde de Fer des Battitures comme Pigments pour Peintures antirouille) H. RABATE. *Usine*, Vol. 45, Apr. 23, 1936, pages 37-39. The use of the various Fe oxides, with exception of FeO due to its chemical instability, as pigments, is discussed and the widening use of artificial oxides made from scale according to several patents (French No. 532400, DRP 25683, 389161, 394131) is described. Vehicles, thinners, and admixtures especially Al powders to obtain special appearances are described. Ha (8f)

Blisters in Enamel and Their Causes (Emailblasen und ihre Ursachen) LUDWIG STUCKERT. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie*, No. 11, 1934, pages 25-46. A discussion of the causes of defective enamel on steel sheet. Defects may be attributable to the enamel, the steel or to the processing. Typical defects are shown. JLG (8f)

Blisters in Enamel Over Welds (Die Blasenbildung im Email auf Schweissnähten) M. v. SCHWARZ & F. GOLDMANN. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie*, No. 11, 1934, pages 1-9. Discusses causes of blisters and gives following suggestions for avoiding them. Avoid steel sheet containing slag, gas, or S inclusions. Use narrow and regular overlap, avoid leaving sharp corners, also slow welding that changes structure of sheet near weld. Enameling too soon or too long after welding is inadvisable. Avoid sheet that has been critically cold rolled after final annealing or sheet that has been annealed above the upper critical temperature. JLG (8f)

Rust-proofing and Paint-adherence. F. P. SPRUANCE. *Automobile Engineer*, Vol. 26, Jan. 1936, pages 41-42. See *Metals & Alloys*, Vol. 7, May 1936, page MA 246L/6. Ha (8f)

Effect of Mill Additions on the Thermal Expansion of Sheet-Iron Ground Coat Enamels. R. L. FELLOWS & E. E. HOWE. *Journal American Ceramic Society*, Vol. 19, Apr. 1936, pages 109-111. 13 batches of enamel of varying composition were investigated. The results are given in curves and tables for 2-frit ground coat. WB (8f)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9. TESTING

Metallurgical Control in the Production of Non-Ferrous Sheet and Strip. A. F. Dunbar. *Metal Industry,* London, Vol. 47, Dec. 20, 1935, pages 603-607; Dec. 27, 1935, pages 630-632. A lecture by the metallurgist at the Ammunition Factory of the Munitions Supply Board of Australia. Describes the foundry and rolling mill practice at the ammunition factory of the Munitions Board with particular reference to controlling quality. Listed as representative of the various classes of alloys produced are brasses, gilding metal, platers' metal, phosphor-bronze, Al-bronze, cupro-Ni, Ni-Ag and key-metal. Their approximate composition and uses are indicated. The quality of the raw material used and the effects of the several impurities on the different alloys are discussed. Foundry equipment, dressings for ingot molds, fluxes used for non-ferrous alloys, couples, and typical pouring temperatures are briefly discussed. The principal causes of defects in the finished material that are attributed to the foundry are (1) too high pouring temperatures which result in coarser grained material and produce cracks on rolling, particularly on the break-down rolls, (2) too low a pouring temperature, which results in (a) "double-strip" caused by a so-called "loose centre," i.e., a central cavity not observed during cropping, and (b) "blisters," caused by trapped gas during solidification, and (3) incorrect feeding, which results in subsurface cavities. The methods of sampling for chemical analysis are indicated. The rolling mill operation is described from the surfacing of the ingot prior to rolling to the finished material which is supplied in a number of degrees of hardness. The different physical testing methods used include (a) Shore hardness, (b) Erichsen cupping tests, (c) Vickers hardness, (d) tensile tests, and (e) microscopic examination. For the latter work a Vickers projection microscope is used because of its several advantages. HBG (9)

■ 9a. Inspection & Defects, including X-Ray Inspection ■

C. S. BARRETT, SECTION EDITOR

Some Applications of X-Rays to Industrial Problems. J. R. Townsend & L. E. Abbott. *Metal Progress,* Vol. 29, Feb. 1936, pages 64-70, 86. Reports work on sensitivity of X-rays in detecting small cracks and defects. Various applications of X-rays and gamma rays to non-destructive examination of industrial structures are described. WLC (9a)

Industrial X-Rays. An Introduction to the Physics of the Science. Robert C. Woods. *Metals & Alloys,* Vol. 7, Feb. 1936, pages 45-50. Descriptive of the nature and effects produced by X-rays. WLC (9a)

■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

The Upper and Lower Yield Points and the Breaking Strain. G. Welter. *Metallurgia,* Vol. 13, Apr. 1936, pages 183-187. Describes further experiments that show phenomenon of upper and lower yield points to be attributable to the testing machine and not to the material tested. At the yield point an accelerated yielding of the material takes place, due to which no drop in load from an upper to a lower load stage of the test bar results. Similarly, the decline in loading from the maximum load to the breaking load on the material is a matter of a peculiarity of the machine, according to which the actual conditions obtaining in the tensile test are not reproduced true to reality. JLG (9b)

Does Upper and Lower Yield Point Have Actual Existence? G. Welter. *Metal Progress,* Vol. 29, Mar. 1936, pages 66-67. Due to small motion of head of most testing machines corresponding to a large load a sudden yielding of specimen results in drop on autographic record of load-extension. Where precautions are taken by design of machine or application of a dead load such drops in load are not recorded and the load continuously increases through the yield point. WLC (9b)

Mechanical Tests for Engineering Materials. A. M. Roberts. Draughtsman Publishing Co., Ltd., London, 1936. Paper, 5½ x 8½ inches, 89 pages. Price 4s.

In the introduction, the author states "The excuse for introducing yet another publication on this subject is to be found in the need for a brief treatment giving concisely the methods and purposes of the more usual forms of test, which it is hoped will be sufficiently comprehensive to meeet most of the needs of the designer or draughtsman without introducing details and arguments, which are only of real value to the person actually engaged in testing. The pamphlet is, therefore, written specifically for the engineer and draughtsman who, unfamiliar with testing methods, meets the problem of deciding what tests it is necessary to apply to the machine or structural part which he has designed and for which he wishes to insure a satisfactory performance under the service conditions with which he is acquainted."

The pamphlet describes various tests and testing machines (English): tensile, bend, hardness, impact, transverse on cast iron, fatigue, creep, tests on welds and cement, test procedure. Richard Rimbach (9b) -B-

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Recommended Practice for Thermal Analysis of Steel. *American Society Testing Materials,* A. S. T. M. Designation: E 14-33; *American Standards Association,* A. S. A. No.: Z 30.2-1936, 4 pages. AHE (9b)

New Metrological Application of Amplifying Tripod Movable Around a Fixed Point. Machine for Graphic Recording of Mechanical Testing of Metals (Nouvelle application métrologique du trepied amplificateur mobile autour d'un point fixe. Machine à enregistrement graphique pour l'essai mécanique des métaux) PIERRE CHEVENARD. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 280-287. Mechanical features of a device registering strain stress diagram in ink. The principles involved are identical with those formerly described (*Bulletin de la Societe d'Encouragement pour l'Industrie Nationale,* Jan. 1935, page 59) but the size of specimens is larger. The device is applicable to tensile, shear and bend testing. JDG (9b)

Mechanical Testing of Aluminum and Aluminum Alloys (Mechanische Prüfung von Aluminium und Aluminiumlegierungen) R. IRMANN. *Aluminium,* Vol. 18, May 1936, pages 192-202. The test methods for determining the static properties of Al and Al alloys are reviewed, preparation of specimens is described, and a tabulation given showing which of the different tests (tensile, hardness, bending, impact, deep-drawing) can be made on the material in the form of sheets, wire and profiles. The German standards and definitions are described. Ha (9b)

International Standardization of the Impact Bending Test (Die zwischenstaatliche Normung der Kerbschlagbiegeprobe) A. LEON. *Montanistische Rundschau,* Vol. 27, May 16, 1936, pages 2-5. A summary of the efforts made to standardize the impact bending tests at the various international congresses held since 1906 in the field of materials testing. Much space is given to the 1933 meeting at Düsseldorf, where it was decided to carry out tests with 2, 3 and 5 mm. notches, to determine the most suitable depth of notch. These tests were to be carried out in several countries. The results of the French tests are given in the article; they show that the 5 mm. notch is the most satisfactory. BHS (9b)

An Improved Method for Preparing Cast-Iron Transverse Test Bars. A. I. KRYNITSKY & C. M. SAEGER, JR. *Bureau of Standards Journal of Research,* Vol. 16, Apr. 1936, pages 367-384. The importance of preparing cast-Fe transverse-strength test bars free from "burnt-on" sand and surface defects is discussed. A molding material and casting technique which will produce such test bars in green-sand molds has been developed. Test bars 0.75", 1.2", 1.5", and 2.2" in diameter and 23" in length were cast in top-poured and bottom-poured vertical molds, horizontal molds, and horizontally inclined molds. The effect of maximum heating temperature on the transverse breaking strength, hardness, primary structure, and microstructure of test bars made by these methods was investigated. Test bars cast in bottom-poured vertical molds yielded the most consistent results. The transverse breaking strength of the irons investigated increased with an increase of the maximum heating temperature, regardless of the casting method employed. A finer primary structure and finer graphite and pearlite constituents were found to be associated with higher transverse strength. WAT (9b)

Determination of the Maximum Temperature Effect During Cross Sectional Reduction of Wire Previously Annealed in an Inert Gas (Bestimmung des Temperaturmaximus in der Umgebung einer Querschnittseinschnürung eines in eimem Inerten Gas Geglühten Drahtes) LEOPOLD PRÁSNIK. *Zeitschrift für Physik,* Vol. 99, Apr. 2, 1936, pages 710-713. Derivation of equations is given to show the maximum temperature rise for different reductions in cross sectional area for W wire which was previously annealed in an inert gas. FHC (9b)

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9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the auhor or the abstractor.

The Relation of Laboratory Research to Engine Design. HUBERT HANTMANN. *Marine News,* Vol. 22, Feb. 1936, pages 29-32. Extracts from a paper read on Jan. 10, 1936 before N. E. Coast Institute of Engineers & Shipbuilders. Influence of fiber on endurance limit, influence of shrink fit, corrosion fatigue and prevention are discussed briefly. WB (9c)

Relation of Fatigue to Modern Engine Design. W. S. BURN. *Gas & Oil Power,* Special Technical Review Number, 1935, pages 50-54. Presented before North East Coast Institution of Engineers & Shipbuilders, Jan. 1935. See *Metals & Alloys,* Vol. 6, May 1935, page MA 200. FPP (9c)

9e. Spectrography

Uses and Limitations of the Spectrograph for Industry Control. THOMAS A. WRIGHT. *Metal Progress,* Vol. 29, Jan. 1936, pages 53-57. A large number of analytical control problems are given in which the solution has been found in the use of the spectrograph. The equipment and its use are described. WLC (9e)

Quantitative Analysis of the Non-Ferrous Alloys by Spectroscopic Methods. R. A. WOLFE. *Metal Industry,* London, Vol. 47, Dec. 27, 1935, pages 633-635. See *Metals & Alloys,* Vol. 7, May 1936, page MA 252L/8. HBG (9e)

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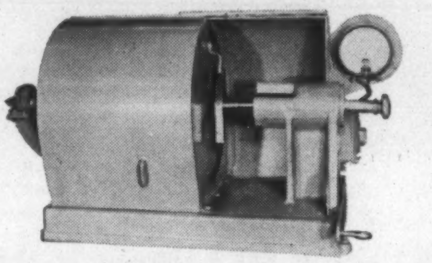
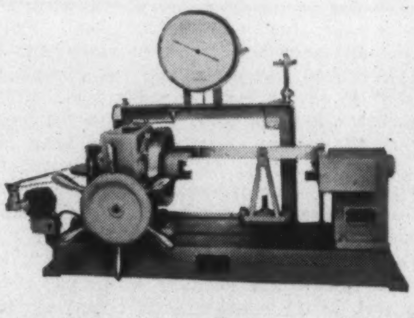


carries impact testing into the high hardness ranges with a high degree of reproducibility—showing in tool steels, for instance, the toughness under various conditions of quenching and drawing. Such impact tests are applicable to all brittle or hard-surfaced materials. They are also a study of the effect of shock on materials stressed in torsion, such as shafts and axles. These tests, in addition, are valuable in the study of the effect of surface corrosion.

Torsion Impact is used principally by steel companies, such as: Bethlehem, Allegheny, American Steel and Wire, Vanadium, Halcomb, Carpenter, Republic and others.

Static Torsion



—for hard and brittle materials. There are two schools of thought relative to the tests on hard metals, such as tool steels. One supports the torsion impact test advanced by the Carpenter Steel Company. The other supports the static torsion test advanced by Emmons of the Cleveland Twist Drill Company.

Each studies the effect of drawing temperature on toughness, but in a distinctly different way.

An ingenious precision torsion machine following Emmons' design has been developed for commercial use.

Dr. Sauveur of Harvard has also approached the study of materials from the point of view of torsion. He has found a relation between creep values and torsion values under constant load at elevated temperatures, and has designed a simplified torsion machine—autographically developing the load-twist curve by means of this machine and exploring very thoroughly the whole subject of torsion. In addition—Southwark's approach toward the study of the damping properties of materials (also known as dynamic ductility) is by the way of torsion. This has had much discussion in technical literature.

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10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

The Constitution of Binary Alloys (Der Aufbau der Zweistofflegierungen) M. HANSEN. Julius Springer, Berlin, 1936. Cloth, 6½ x 9½ inches, 1100 pages. Price 87 RM.

This is one of the most valuable reference books in metallurgy which has appeared in many years. Dr. Hansen has attempted—successfully—to assemble in one volume all of the information available on the constitution and structure of the binary systems of the metals. The effort must have been prodigious: no less than 828 binary systems are discussed, though of course constitution diagrams are not available for all of these. An effort was made to have the references complete up to the fall of 1935, though doubtless this date must not be taken as precise, with the difficulties in obtaining journals promptly, especially from distant countries.

Each binary system is discussed separately, with references given to all of the original papers. Where possible, complete temperature-composition diagrams are given, frequently reinforced by detail drawings on a larger scale of small sections. The discussion is as critical as it can be: work which seems untrustworthy is given little or no weight; of course in the end real criticism requires a repetition of the experimental work, and in lack of this an author can only summarize that which appears in the literature, taking most of it on faith. In many cases, where disagreement obtains, the author reproduces diagrams from a variety of authors, such as in the case of the region surrounding the β phase in the Cu-Zn system, the Wüstite phase in the Fe-O system, and the Al-rich terminal solid solution in the Al-Zn system.

In addition to the obviously metallic systems, systems of Ti, Se, Te, S, P, B, C, N, O, and H are included because of their obvious interest to metallurgists. It is surprising to discover the fact that a number of the praseodymium systems have been rather thoroughly studied by several Italian workers!

Much of the best work on the constitution of metal systems has appeared in the last 15 years. The earlier work was largely performed by thermal analysis and microscopic examination of specimens. Thermal analysis is now rarely used, apart from the determination of liquidus temperatures, and the newer X-ray diffraction methods and modern precision dilatometric methods are used very extensively. With improvement in methods and in materials and with a rapidly growing professional class, ever better trained, the quality of recent work has been very high. The author discusses this newer work thoroughly; he gives in each case the lattice structures of the phases obtaining in the system when these are known.

It is, of course, impossible to tell whether the work is complete,—the critic would have to do as much or more work than the author to tell this! I have discovered no omissions, and I have been surprised several times in the completeness of the references for the systems about which I happen to know something. The treatment of the constitution of the alloys of iron is not as complete as that given in the *Alloys of Iron Monographs,* but the treatment given seems adequate.

The book is delightfully orthodox in its presentation of constitution diagrams: changes from ferromagnetism to paramagnetism are indicated by single *dotted* curves, not to be confused with the boundaries of fields of true heterogeneous equilibrium which are drawn as *solid* curves, as, for example, in the systems Fe-C, Fe-Ni, Cu-Ni, Co-Ni, etc.; nor are solid conjugate curves drawn for those mysterious changes in the solid state leading to the formation of superstructures, as in the Au-Cu, and Cu-Pd systems.

The book is beautifully printed. The arrangement is extremely convenient: the systems are arranged alphabetically according to the symbol for the element appearing first in the alphabet; in this way any system may be readily found without reference to the excellent index. The book will be of great service to the metallurgical profession—it is far superior to all previous efforts along the same line; it has already proved of value in my own laboratory, for it has permitted two research men to select a series of systems for their purposes without the months of literature research which otherwise would have been necessary. How the author purposes in the future to keep the summary up-to-date, I don't know, but some effort should be made for the value of the book is too great to be slowly lost through becoming obsolete. Perhaps Dr. Hansen will similarly honor the metallurgical profession by presenting a like book on the constitution of ternary systems.

The price of this book is very high,—87 marks, and I fear that only libraries—and not all of them—will be able to afford it, yet every research metallurgist will require it for continual use and despite its price it must be recommended without any reservation and with full commendation for a difficult and arduous task accomplished with distinction. Robert F. Mehl (10) -B-

Hydrogen in Steel (Wasserstoff im Stahl) HEINRICH PLOUM. *Chemische Fabrik,* Vol. 9, Apr. 17, 1936, pages 173-177. Steel is capable of dissolving H if the latter be in the atomic state, a condition that may be realized in one of two ways: either by splitting of H molecules into atoms along the surface of a piece of steel heated in a H atmosphere or by the electrolytic evolution of H when steel is dissolved in acid or is treated cathodically without dissolving. An extensive review of the literature concerning both of the foregoing solution mechanisms is presented. Much of the dissolved H escapes at room temperature, and its escape is accelerated with rising temperature. Measurements of H evolution at room temperature show that the original rate of escape is high, but drops as the material becomes impoverished, a certain residue remaining finally. Further evolution occurs on heating. Investigation of the distribution of H across sections of wire and cylinders of varying thicknesses, cathodically treated, showed the surface concentration to be much higher than the internal, while the H absorbed by heating samples in H_2 atmosphere was distributed evenly across the section. The literature and mechanism of H embrittlement are reviewed, and the author's own observations, particularly with Fe wires, are presented. 25 references. FPP (10)

Ferrite Banding in Forged and Rolled Steel. A. V. PROHOROFF. *Metallurgia,* Vol. 13, Apr. 1936, pages 179-181. Reviews theories of ferrite banding and cites experimental study in which plates of different steels were welded together and then heat treated. Results proved that banding resulted from differences in concentration of Si, Mn, Ni or other elements. Some elements cause C increase and others C decrease where they are segregated. It is suggested that ferrite banding may be prevented by balancing the composition of a steel so that the alloying elements which segregate in interdendritic spaces oppose each other in their influence on the direction of C rediffusion on cooling. JLG (10)

The Present Status of Ferromagnetic Theory. R. M. BOZORTH. *Bell System Technical Journal,* Vol. 15, Jan. 1936, pages 63-91; *Electrical Engineering,* Vol. 54, Nov. 1935, pages 1251-1261. This article presents the current conceptions of the nature of ferromagnetism in readily understandable form. Briefly, it is held that the origin of ferromagnetism lies in the magnetic moments of the circulating and spinning electrons of the atom. In a nonmagnetic atom these moments are mutually neutralized within the atom but in a ferromagnetic atom there exist uncompensated electron spins which magnetically polarize the atom. For an element to be ferromagnetic however, not only must its atom contain uncompensated spins, but these must also be parallel from atom to neighboring atom, necessitating powerful "exchange" forces which depend both on the number of uncompensated spins and the distances between them. Even with no applied field these forces hold all electron spins parallel over small regions or "domains" of about 10^{-8} cm.^{3} in volume. In unmagnetized material the spin directions may vary from one "domain" to another. In the process of magnetization there is (1), at low field strengths, a growth of one "domain" at the expense of another, followed by (2), sudden changes of the "domain" spin direction to those directions of easiest magnetization in the crystal lattice which are most nearly parallel to the applied field direction and finally (3) a rotation of the electron spins in each "domain" out of the stable position toward the field direction. These three stages correspond to the initial, middle, and top portions of the magnetization curve. Magnetization may be helped or hindered by homogeneous axial strain because of the magnetic action between neighboring atoms. This action being balanced by electrostatic forces there is bound to be a change in atomic spacing when the material is magnetized (magnetostriction). Material in which local strains are directed at random are hard to magnetize or demagnetize. The effect of local strains on initial permeability can be calculated fairly closely but other properties such as maximum permeability may be estimated only qualitatively at present. HFK (10)

Formation of Spherical Eutectic Inclusions in Alloys (Die Bildung Kugelförmiger eutektischer Einschlüsse in Metallegierungen) W. GELLER. *Metallwirtschaft,* Vol. 15, Feb. 7, 1936, pages 141-142. Spherical eutectic inclusions found especially in high purity Al alloys are droplets enclosed by the matrix during rapid cooling. It is shown that their formation is favored by fast cooling from just above the solidus line and when the temperature range between the liquidus and solidus is small. Their occurrence is also demonstrated in an Fe alloy containing 28% Co and 30% Sn. GD (10)

New Methods for Constitutional Studies (Neuere Verfahren der Konstitutionsforschung) G. GRUBE. *Zeitschrift für Metallkunde,* Vol. 27, Sept. 1935, pages 194-195. Examples are given which show use of magnetic-susceptibility measurements over a range of temperature in determining phase changes for ferro-, para-, and dia-magnetic materials. A simple-but-accurate apparatus for such measurements is described. GD (10)

Variations in Work-function Emission at the Melting Point of Metals (Zur Frage der Austrittsarbeitsänderungen im Schmelzpunkt der Metalle) H. KURZKE. *Zeitschrift für Physik,* Vol. 98, Feb. 3, 1936, pages 684-691. Observations of the electron emission and the photoelectric effect show that for certain metals in the region of their melting points, the work function is greater in the liquid than in the solid state. FHC (10)

Inner Potentials of Crystals and the Electron Diffraction. W. E. LASCHKAREW. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1081-1095. The present state of the question of the inner or the "effective" potential in relation to electron diffraction is discussed. The "effective" potential is not a constant but increases with the order of the diffracted reflection. A new method for calculating the potential distribution in the grating and the mean grating potential from X-ray data is given. The independence of the "effective" potential value from the presence or absence of free electrons in the grating is pointed out. Difficulties are discussed which arise in the determination of the "effective" potential when using diffraction of slow electrons. By considering the temperature factor it is possible to arrive at unique reflection orders and a unique determination of the "effective" potential. 26 references. PRK (10)

Investigation of the Mg-Cu-Al System, Especially the $MgCu_2$-$MgAl_2$ Section (Untersuchungen im System Mg-Cu-Al, speziell auf dem Schnitt $MgCu_2$-$MgAl_2$) F. LAVES & H. WITTE. *Metallwirtschaft,* Vol. 15, Jan. 3, 1936, pages 15-22. Thermal, X-ray, and microscopic studies were made on alloys along the Mg-Cu_2-$MgAl_2$ section at compositions from 0-85 mol. % $MgAl_2$ with 5% increments. Beyond 45% the alloys prepared by melting were not homogeneous and specimens were made by annealing compressed powders of $CuAl_2 + Mg + Al$. A large part of the Al corner was roughly explored with these powder samples. It was found that the cubic $MgCu_2$ formed a solid solution up to 35% $MgAl_2$ with a regular increase in lattice constant. From 35 to about 52% $MgAl_2$ the hexagonal lattice of the $MgNi_2$ type was found, but annealing at 500° produced the hexagonal lattice of the $MgZn_2$ type, which was also formed in the alloys up to 60% $MgAl_2$. It was evident that some crystallographic mechanism controlled the transformation from $MgNi_2$ to the $MgZn_2$ lattice. Other ternary compounds corresponding to the formulas $Mg_2Cu_2Al_5$ and $Mg_3Cu_7Al_{10}$ were found. GD (10)

The Structure of Polished Metal Surfaces. C. S. LEES. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1102-1106. Surfaces of Cu and Au were polished. 3 methods of polishing Cu were used and one of polishing Au. Surfaces were etched electrolytically and photographed by electron diffraction. The Beilby layer was found to be separated from the non-oriented polycrystalline interior of the metal by a layer of oriented crystals. The thicknesses of the 2 layers were estimated on Cu. The amorphous layer extended from 0 to 45 A.U. and the oriented layer extended from 0 to 300 A.U., according to the polishing technique on Cu. Au has a much thicker oriented layer than Cu. The orientation appears to be due to deformation of the crystals by compression. The actual surface cannot consist of crystal faces. 8 references. PRK (10)

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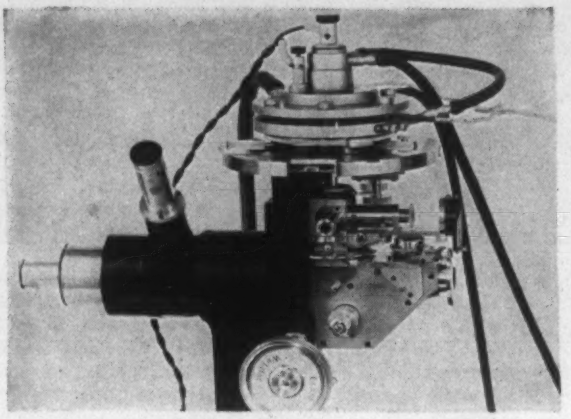

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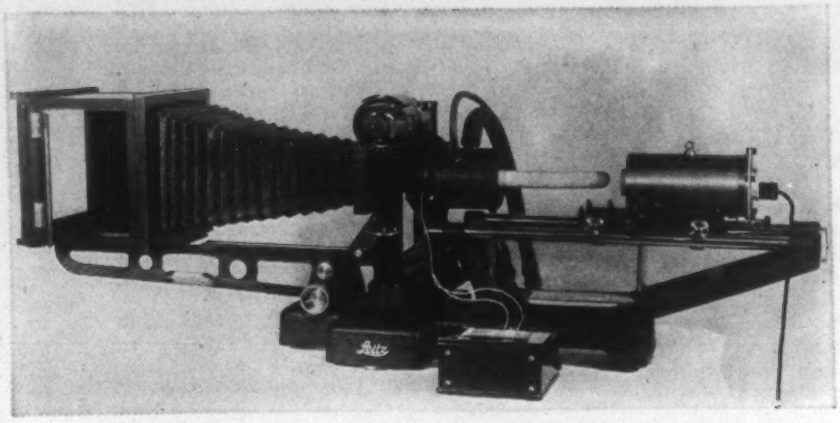

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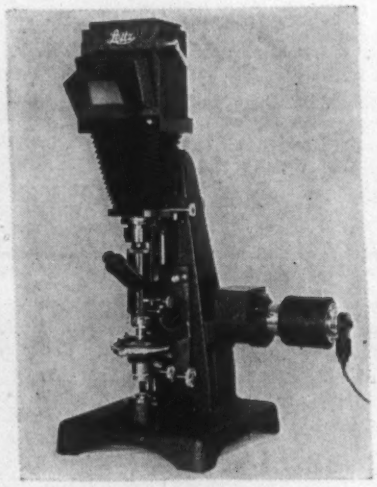

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Etch Planes of Tin. L. W. McKeehan & Harold J. Hoge. *Zeitschrift für Kristallographie,* Vol. 92. Dec. 1935, pages 476-478. In English. Etch planes of Sn were developed by etching with HCl and small additions of $KClO_3$. For alloys with 0.6% Sb the acid had to be dilute. Alloys with Cd and Ga additions up to 1% were intermediate in resistance to attack between these extremes. The sharply defined etch planes are listed. They were accurate enough to dispense with time-consuming X-ray analyses. EF (10)

Manner of Reaction of Carbide Etching Reagents (Wirkungsweise der Karbidätzmittel) R. Mitsche. *Archiv für das Eisenhüttenwesen,* Vol. 9, Dec. 1935, pages 311-312. For carbide etching the presence of an oxidizing agent along with the alkali is necessary. A suitable reagent proved to be $KMnO_4$ in KOH or NaOH. Ferrohydroxide formed on the cementite by the attack of the caustic is oxidized to ferrihydroxide, which deposits on the cementite and gives it a dark color according to the length of etching. SE (10)

Recrystallization and Grain Growth in Cold-worked Polycrystalline Metals. L. W. Eastwood, Arthur E. Bousu & C. T. Eddy. *Transactions American Institute of Mining & Metallurgical Engineers,* Vol. 117, 1935, pages 246-264. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 142L/2. (10)

Phase Changes During Aging of Zinc-alloy Die Castings, II—Changes in the Solid Solution of Aluminum in Zinc and Their Relation to Dimensional Changes. M. L. Fuller & R. L. Wilcox. *Metals Technology, American Institute Mining & Metallurgical Engineers Technical Publication* No. 657, Dec. 1935, 13 pages. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 142R/4. JLG (10)

Panphot, a New Photo-metal Microscope (Panphot, ein neues Photo-Metallmikroskop) Hugo Freund. *Autogene Metallbearbeitung,* Vol. 29, Mar. 1, 1936, pages 69-72. See also *Metals & Alloys,* Vol. 6, May 1935, page MA 205R/10. Ha (10)

Electron Diffraction and Surface Structure. G. I. Finch, A. G. Quarrell & H. Wilman. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1051-1080; discussion starts on page 1107. The present state of the technique of electron diffraction is outlined and the directions in which this new method is being applied are illustrated. Precision cameras, small cameras, high voltage supply, vacuum technique, the preparation and cleaning of specimens, the theory and interpretation of electron diffraction patterns are discussed. 27 references. PRK (10)

The Ternary System FeO-MnO-SiO₂. W. R. Maddocks. *Iron & Steel Institute, Carnegie Scholarship Memoirs,* Vol. 24, 1935, pages 51-68. The system FeO-MnO-SiO_2 was studied using various slags made from pure FeO, MnO, and SiO_2, and the melting surface of a wide range of compositions was determined. A ternary eutectic having the composition 50% FeO, 20% MnO, and 30% SiO_2 was observed which melts at 1170° C. A ternary diagram is constructed, and the usefulness of this in understanding the behavior of acid open-hearth slags and the deoxidation of steel is given. Thermal analyses were made of pure melts contained in Mo crucibles. A differential Mo-W thermocouple connected to a galvanometer served for indicating thermal arrests and a Mo-W couple connected to a potentiometer indicated temperature. 10 references. CW (10)

Relation Between Diffusion and Structure of Solid Alloys (Beziehung zwischen Diffusion und Aufbau fester Legierungen) W. Seith & A. Keil. *Zeitschrift für Metallkunde,* Vol. 27, Sept. 1935, pages 213-216. With discussion. A survey of diffusion experiments shows that the temperature dependence of diffusion is given by the equation $\ln D = A - \frac{Q}{RT}$ where A and Q are constants. The rate of diffusion of component A in matrix B will be the greater the closer B is to its melting point, both the rate and the melting point being related to the vibrational energy of the lattice in the same way; thus the self-diffusion of Pb at a given temperature is increased by the addition of Bi, which lowers the melting point, but not by Tl which raises it. Similarly diffusion is markedly rapid during recrystallization and during allotropic transformation. The rate of diffusion of B in A is inversely proportional to the tendency of B to form solid solutions in A, as shown by studies of a series of Pb alloys. Material transport, corresponding to that calculated for C with a double positive charge, is shown if carburized Fe is heated above Ag by a direct current. GD (10)

Investigation of the Heats of Transformation of Iron (Untersuchung über die Wärmetönung bei den Umwandlungen des Eisens) H. Steinwehr & A. Schulze. *Zeitschrift für Metallkunde,* Vol. 27, Dec. 1935, page 289. Corrections to the article of the same title, *Zeitschrift für Metallkunde,* Vol. 27, June 1935, page 129. FNR (10)

Precipitation from Supersaturated Solid Solutions Across a Temperature Gradient (Die Ausscheidungen aus übersätigten Mischkristallen in einen Temperaturgefälle) G. Tammann & W. Boehme. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 226, Dec. 31, 1935, pages 87-91. A method is described for imposing a nearly linear temperature gradient on a rod of metal (in this case Cu with 6.1% Ag and duralumin). The rod is thereafter surveyed for hardness and the temperature corresponding to the point of maximum hardness is determined Apparatus consists of a Cu block heated to desired temperature and heat is conducted to 100-mm. long rod to be tested, through end screwed in Cu block. The other end of rod is clamped to a Cu block, water cooled. Thermocouples are placed in the rod at both ends and in center. A heat insulating sheath covers the rod between the Cu blocks. Curves are given for the 2 solid solutions investigated. On polishing the length of the rod and etching, the regions of precipitation could be determined with microscope. In the Cu-Ag alloy after 10 hrs., precipitation begins at about 210° C. and at 250° C. is visible under microscope; maximum hardness occurs at 300°-350° C. For the duralumin (4% Cu, 0.5% Mg, 0.5% Si) after 3½ hrs., maximum hardness occurs at 167°-200° C. and precipitate at 700 × becomes visible at 300° C. There is not an exact correspondence between hardness and precipitated phase as is corroborated by X-ray investigations (Göler & G. Sachs, *Zeitschrift für Metallkunde,* Vol. 19, 1927, page 90). Discussion of precipitation hardening and lattice parameter follows. WB (10)

Some Recrystallization Phenomena (Quelques phénomènes de recrystallisation) A. E. van Arkel. *Revue de Métallurgie,* Vol. 33, Mar. 1936, pages 197-202. A summary. When crystals slide along their cleavage planes the crystallites adjoining them turn on an axis perpendicular to the direction of rolling. This produces distortion in space lattice, which is never restored by drawing. High temperature to which a metal can be subjected reduces the friction between distorted crystallites, and they return almost to their original position. In recrystallization, atoms rearrange themselves instead of whole crystallites. Recrystallization depends on the number of nuclei of crystallization and these are controlled by the amount of deformation. Linear speed of recrystallization is a function of deformation and temperature. Sheets were punch marked and stretched to produce strain concentration at the edges of these marks. These start large grains in annealing. Sheets in process of recrystallization, strained and annealed, are composed of large crystals only. The same deformation which was sufficient to start grain growth on original sheets has no effect after sheets were recrystallized, indicating that small deformed crystals do not act as crystallization nuclei. Undeformed grains cannot be considered as nuclei. In transition from α to γ state the number of nuclei is independent of the size of crystals, untransformed α forming a number of transition points increasing with the state of deformation. Crystallization nuclei in undeformed α act as transition nuclei. In Al secondary recrystallization takes place after a deformation of 30% and annealing at 600° C. producing thousands of small crystals oriented similarly in areas which were occupied by original grains before deformation. On additional heating they unite in grains corresponding both in shape and orientation to the original. The phenomenon can occur only when certain conditions are fulfilled. JDG (10)

Silver-gallium Diagram (Das Zustandsdiagramm des Systems Silber-Gallium) Friedrich Weibke, Karl Meisel & Lotte Wiegels. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 226, Feb. 7, 1936, pages 201-208. Thermal analysis, diagram, and X-ray data are given. Experimental work and phases found are discussed. WB (10)

Information on Metallurgical Processes Obtained by Radioactive Experiments (Nachweis metallkundlicher Vorgänge durch radioactive Verfahren) O. Werner. *Zeitschrift für Metallkunde,* Vol. 27, Sept. 1935, pages 215-219. A qualitative picture of the diffusion of emanation through the metal lattice is developed whereby only the lattice atoms having the highest vibrational energy have an important influence on the heavy emanation. As a consequence of this the temperature coefficient of the diffusion of emanation is inversely proportional to the Debye characteristic temperature of the metal. Due to this importance of vibrational energy of the matrix, grain boundaries have a marked influence, and any process altering the energy characteristics of the material, such as mechanical work, precipitation, transformations, recrystallization, sintering of powdered metal, can be observed by radioactivity experiments. The presence of impurities in the material, especially gases, must be avoided. GD (10)

The Effects of Heat Treatment on Carbon Steels. E. Widdowson. *Machinery,* London, Vol. 47, Feb. 6, 1936, pages 557-560. General. WB (10)

Determination of Best Hardening Temperature for Duralumin Alloys (Versuche zur Ermittlung der günstigsten Aushärtungstemperatur bei Durallegierungen) U. v. Scheidt. *Zeitschrift für Metallkunde,* Vol. 27, Dec. 1935, pages 275-277. Because homogenization of duralumin is most readily accomplished at the highest temperature below that of the solidus, and, because small variations in the Si, Mg and Mn, as well as the Cu content of the alloy have pronounced effects upon the location of the solidus, the heat treating temperature of duralumin should be adjusted to conform with the requirement of each alloy. Four commercial duralumin alloys analyzing A (Cu 4.12%, Mg 0.84%, Si 0.23%, Mn 0.52%), B (Cu 4.21%, Mg 0.49%, Si 0.34%, Mn 0.35%), C (Cu 3.63%, Mg 1.07%, Si 0.58%, Mn 1.12%) and D (Cu 4.07%, Mg 0.74%, Si 0.38%, Mn 0.63%) were each subjected to 20 minute homogenizing treatments at 10 temperatures ranging from 493° C. to 576° C., and were quenched in water at room temperature. After aging at room temperature for 2 to 3 weeks they were tested to determine the resulting values of yield point (0.02 and 0.2% extension), ultimate strength, elongation, and bend count. By plotting the values of the mechanical properties of each alloy against homogenizing temperature, the most favorable temperature for the treatment of each alloy was shown to be: A 510° ± 2.5° C.; B 515° ± 2.5° C.; C 505° ± 2.5° C.; and D 512° ± 2.5° C. Loss of strength through "burning" occurred at A 530° to 535° C., B 538° C., C 520° to 521° C., and D 533° to 535° C. The following empirical formula for computing the best homogenizing temperatures for duralumin of various compositions was developed: $t = [548 - (5.65 - \%\ Cu) \cdot 9.04] - (40.3 : \%\ Mg + 31099 \cdot \%\ Si - 32.5 \cdot \%\ Mn) \pm 2.5°\ C.$ FNR (10)

The Irreversibility of the Iron-nickel Alloys and Their Equilibrium Diagram (Die Irreversibilität der Eisen-Nickel-Legierungen und ihr Gleichgewichtsschaubild) E. Scheil. *Archiv für das Eisenhüttenwesen,* Vol. 9, Sept. 1935, pages 163-166. The irreversible field in Ni steels is wide and at a certain temperature range results in a transformation. The irreversible field is attributed to a combination of fast lattice changes and slow changes in composition by diffusion. From the measurements 2 hitherto undetermined points on the Fe-Ni diagram were determined. With the aid of these points the equilibrium temperature of the α-γ change in the composition range 0 to 10% Ni was plotted. SE (10)

Statistical Studies of Structure (Statistische Gefügeuntersuchungen) E. Scheil. *Zeitschrift für Metallkunde,* Vol. 27, Sept. 1935, pages 199-209. With discussion. The already great usefulness of the metallurgical microscope can be increased and be made quantitative, rather than qualitative, by the application of statistical methods of analysis. An example of the integration method is the comparison of special samples with standard grain-size charts. Individual observations can also be made valuable by plotting a distribution curve for large numbers of them. Simple graphical methods for such studies are explained. Results already obtained from deformation measurements on individual crystals, as well as the relative deformation of slag inclusions and the effect of temperature upon this property are cited. A treatment is given of the determination of spatial grain size from two-dimensional observation of the number and size distribution of grains. This is based upon the assumption that the grains may be considered as spheres. Additional applications of statistical analysis to such problems as directional distribution of structural features, dendrite studies, dimensions of eutectic structures, and experimental confirmation of statistical theories are suggested. GD (10)

Study of Metallic Crystals (Sur l'étude des cristaux métalliques) E. SCHMID. *Revue de Métallurgie,* Vol. 32, Dec. 1935, pages 638-648. Summary of the present views on the nature and processes of deformation of single crystals. 28 references. JDG (10)

Thermal Expansion and Constitution of Antimony (Ueber thermische Ausdehnung und Konstitution des Antimons) A. SCHULZE. *Zeitschrift für Metallkunde,* Vol. 27, Dec. 1935, pages 286-287. A review of work on anisotropy of thermal expansion and electric conductivity of Sb and of the search for allotropic modifications of Sb, dealing chiefly with the investigations of P. Hidnert (*National Bureau of Standards, Journal of Research,* Vol. 14, No. 5, 1935, pages 523-544). It is concluded that Sb undergoes no allotropic transformation between room temperature and 600° C. FNR (10)

Studies of the Crystal Structure of Some Be Alloys (Kristallstrukturelle Untersuchungen von einigen Berylliumlegierungen) L. MISCH. *Metallwirtschaft,* Vol. 15, Feb. 14, 1936, pages 163-166. The following structures are determined: CoBe and PdBe are of the body-centered cubic CsCl type with $a_0 = 2.606$ and 2.813 A.U. respectively. $AgBe_2$ and $TiBe_2$ are of the face-centered cubic $MgCu_2$ type with $a_0 = 6.287$ and 6.435 A.U. respectively. $CrBe_2$, $MnBe_2$, VBe_2, $ReBe_2$, $MoBe_2$, and WBe_2 all occur with the hexagonal structure of the $MgZn_2$ type; the lattice constants and parameters were determined. With atomic ratios of about 1:2, Ir-Be and Rh-Be have similar complex structures with isotropic properties. Alloys of Be with Rh and Os have similar structures. Pt-Be form one compound, which is of a deformed γ-brass type. Zr-Be with an atomic ratio of 1:2 has a strongly isotropic lattice of a deformed cubic type. Be-rich alloys with Mo, W, and Ta form tetragonal lattices. Be-rich alloys with Co form a strongly isotropic phase similar to those with Fe. These structures are listed, along with previously determined crystallographic data for many Be alloys. It is observed that with the exception of CuBe, the Hume-Rothery rule is not obeyed for alloys of the cubic AB structure, and that the hexagonal AB_2 lattice occurs only when the cubic AB lattice is not found, i.e., when A is body-centered cubic. GD (10)

Effect of Decarburization on the Microstructure of Quenched High Speed Steels. TAKEJIRO MURAKAMI & ATSUYOSHI HATTA. *Tetsu to Hagane,* Vol. 21, Dec. 25, 1935, pages 993-997. In Japanese. In microstructure of high speed steel quenched from a high temperature such as 1300° C., troostitic structure often appears in its decarburized part. In order to elucidate the formation of the structure, a sectional diagram of 18% W and 4% Cr with varying C content was constructed by means of thermal analysis, differential dilatometric measurement and microscopic investigation. From the diagram obtained the change of microstructure of the high speed steels with different C content cooled from the melt was made clear. The troostitic structure also appears in the low C high speed steel cooled from the melt owing to the occurrence of a eutectoid reaction, $\gamma \rightarrow \alpha + \eta$, in the temperature range below 1340°. The formation of the similar troostitic structure observable in decarburized portion of quenched high speed steel is, therefore, attributed to the same reaction taking place during rapid cooling. TS (10)

Experimental Study of Heterogeneity of Metals and Alloys (Etude expérimentale de l'hétérogéneité des métaux et alliages) ALBERT PORTEVIN & PIERRE CHEVENARD. *Revue de Métallurgie,* Vol. 33, Feb. 1936, pages 96-113. Heterogeneity of metals can be caused by liquation phenomena, major segregation, and secondary liquation occurring on solidification and fusion or during allotropic transformation when the changes from one phase to another are not fully completed. Structural heterogeneity is caused by the orientation of crystals. Heterogeneity can be determined qualitatively by chemical means. Physical methods offer a better way of approach, such as determination of ferromagnetic curve, hardness measurements with a diamond point device, microtesting machine proposed by Chevenard, etc. Thermomagnetic curve obtained on specimens free from heterogeneity shifts from its original position when heterogeneity is produced, and the amount of this shifting permits determining the intensity of this phenomenon. Applied to carburized Ni-Cr alloys the method permitted establishing of secondary liquation in ingots as cast. As neither solution nor precipitation of particles takes place instantaneously, a concentration gradient builds around them until equilibrium is established. Thermal treatment and deformation influence on secondary liquation of Ni-Cr-C alloys were studied and reported. All show the existence of concentration heterogeneity in solid solutions, showing that the present theories should be augmented by the conception of it. For example, hardening produced by drawing specimens quenched from very high temperatures and observed before any visible precipitation takes place should be attributed to heterogeneity inevitably preceding precipitation rather than to atomic phenomena. JDG (10)

New Method for Determination of Transformation Points (Über eine neue Methode zur Bestimmung Umwandlungspunkten) H. NIPPER & E. LIPS. *Zeitschrift für Metallkunde,* Vol. 27, Oct. 1935, pages 242-243. Mechanical properties of metals are found to be more sensitive indicators of certain types of phase transformation than are the more commonly measured properties. This is particularly true at the solidus transformation where, upon heating, liquid is formed at the grain boundaries with a consequent sudden lowering of tensile strength. An apparatus has been constructed for applying a torsional load to a wire specimen the temperature of which may be controlled accurately. The torsional response is recorded automatically and a plot of stress vs. temperature obtained. As a test of the equipment, two points on the Cu-Ag solidus were located with precision far greater than could be obtained by thermal analysis. FNR (10)

Effect of Cold Deformation on the Behavior of an Austenitic Silico-manganese Steel During Tempering (Einfluss der Kaltverformung auf das Verhalten eines austenitischen Silizium-Mangan-Stahles beim Anlassen) F. BOLLENRATH. *Archiv für das Eisenhüttenwesen,* Vol. 9, Sept. 1935, pages 155-162. A 2% C, 1% Si, and 3% Mn steel was made austenitic by quenching, then cold worked and tempered. Dilatation-temperature curves on heating indicated that carbide separated out first, after which the γ-α change occurred. With increasing cold work the temperature ranges of these changes were lowered and narrowed. In severely deformed steel the γ-α change occurred more readily directly after, or even during, the precipitation of carbides; the precipitated carbides were also readily spheroidized. The greatest hardening took place during precipitation of the carbides rather than after the γ-α change as in unalloyed steels. After precipitation the hardness changed more with temperature than in austenitic steels. The greatest hardening was obtained after slight deformation. SE (10)

Metallurgical Dialogue. ALBERT SAUVEUR. American Society for Metals, Cleveland, 1935. Cloth, 5½ x 8¼ inches, 166 pages. Price $3.00.

This is a delightful book!

A modern student, by no means embarrassed in the presence of his august professor, asks a simple question, "Master, do we know why steel hardens when plunged red hot in cold water?" But the master asks in reply whether the pupil knows what steel is, what red hot means,—and we have as a result 166 pages of Socratic discussion of iron and steel: the historical development of theories, practice, nomenclature, in fact almost everything relating to the metallurgy of iron and steel. The pupil is acute and not restrained from making remarks verging on impertinence, nor from interrupting the master in his infinite peregrinations to ask whether the original question will *ever* be answered. But the master is good-humored, tolerant, and intellectually benign, favoring his pupil's intellectual appetite and impatience; he treats his pupil (and the reader) to as interesting a discussion of the important aspects of his subject as one might hope to find in lay language, not hesitating meanwhile to dissertate upon such diverse subjects as the futility of academic degrees, of course not of education, the vanities and conceits of scientists, the ideals of science (with the sophistication of the French), and—but the list is nearly endless. We may readily recognize the master—he is Professor Sauveur himself! And his former students may wonder with some trepidation about the identity of the saucy student!

The master is distrustful (cautious would probably be a better word) of speculation, and not over-impressed with the preeminence of modern accomplishments in comparison with those of earlier years; this is, of course, as it should be, but it is well to be reminded. The master loves true humility:

"M. He (Röntgen) called them X-rays because he did not know their nature.

"P. That was foxy of him. I wonder what he would have done, if there had not been a letter X in our alphabet?

"M. I admit that the letter X is a very useful letter and one that might be used more frequently by some scientists. As it implies an admission of ignorance, however, there are some who are—shall we say too proud?—to make use of it.

"P. That seems to me to be a false pride, unworthy of a true scientist. Conceit is a better name for it.

"M. I think as you do."

"M. You must do your own thinking and weigh the evidence offered.

"P. Some scientists do not like to have you disagree with them.

"M. That is true and this peculiarity is not confined to scientists. It is an unfortunate attitude which must interfere rather than help in their activities which should be the relentless pursuit of truth. It also diminishes our confidence in the accuracy of their conclusions and detracts from whatever personal attraction they may have.

"P. You are severe with the conceited man of science.

"M. This severity, I think, is justified. Let me urge you to avoid dogmatism and conceit."

We find the names long famous in metallurgy scattered through the book, Osmond, LeChatelier, Roberts-Austen, Percy, Arnold, Howe, and many others, with their portraits and with copious quotations from their writings which at times seem quite modern. It cannot be denied that their writings often were more sparkling than modern writing, in the cold matter-of-fact style now demanded of scientists. In speaking of recalescence, Howe said:

". . . by relatively rapid cooling we can carry the metal considerably below Ar, without giving the Ar_1 change time to proceed far, strengthening the while the tendency toward this change, which keeps kindling more and more till it bursts into a blaze, with such evolution of heat as actually to recalesce, to raise the temperature of the metal by some 10° C. in spite of the continued cooling of the furnace."

The discussion of early theories of the hardening of steel, and the old polemic centering about β iron are as fresh as though the arguments had been alive yesterday; however greatly the reader may feel driven to argue his own views, in this or other connections, he finds the master's detachment and mental adroitness more than his equal. It is amusing that the argument concerning the nature of the A_2 change in iron, once so violent, seems now to be revived in a somewhat similar form in the case of the changes which accompany super-lattice formation, for in this case also the application of the term "phase change" is beset with difficulties. We can only agree that definitions are devilishly awkward things in metallurgy as elsewhere.

One last quotation can hardly be resisted:

"Scientific honesty demands that you play havoc with the pet theories of your best friends, if they stand in your way, and if it is necessary in order to support your views—and our best friends should not in the least resent it. Let them reply in kind, if they have the ammunition. We are all traveling towards the same destination, although we may disagree as to the best road to follow and it is proper that we should place as many obstacles as we can in the path of those who, in our opinion, are following the wrong direction."

This independence of mind,—the humility, tolerance, and courtesy so much in evidence elsewhere, are qualities that all recognize in Professor Sauveur.

It must not be supposed that the book is for entertainment alone; it is a serious discussion of the science of iron and steel, put—for once—in a palatable and brief form. No metallurgist should fail to read it, nor to own it, for it is instinctive and delightful as well to the old and tried as to the young and uninitiate. Robert F. Mehl (10) -B-

Creep and Twinning in Zinc Single Crystals. RICHARD F. MILLER. *Metals Technology,* Apr. 1936, *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 703, 15 pages. Zn single crystals ½" in diameter and 10" long (purity 99.999%), grown by the Bridgman method, were subjected to creep tests. A modification of the 2-microscope extensometer was employed, each microscope having a triple lens system, a magnification of 125x, a working distance of 3", and an accuracy of 3.3 x 10^{-6} in./in. on a 6" gage length. Creep was found to obey the crystallographic laws of glide. Much creep occurred with resolved shearing stresses as low as 2.8 g./mm.^{2} at 25° C., confirming Taylor's theory. No evidence was found of an elastic limit, nor of a critical temperature below which a definite shearing stress might occur. Remarkable ductility was maintained at lower temperatures, the ductile crystals bending readily under their own weight at the temperature of liquid air. Twinning on a 2nd order pyramidal plane of variable index was noted to be a characteristic of the early stages of the flexural gliding process, partly accounting for the phenomenon of shear strengthening. In contrast to the absence of measurable critical stress for glide, there was a large threshold stress for twinning on $\{10\bar{1}2\}$, which varied inversely with the amount of preceding basal glide. This observation may explain the difficulty of previous investigators in obtaining a constant twinning stress in different crystals at any one temperature. 15 references. JLG (10)

11. PROPERTIES OF METALS AND ALLOYS

Mechanical-technical Properties of the Pure Metals (Die Mechanisch-technologischen Eigenschaften der reinen Metalle). A. Burkhardt with the collaboration of G. Sachs. First sub-section of the tenth section **(Mechanical-technical Metallurgy)** of the second part **(Physical Metallurgy)** of the second volume **(The Properties of Metals and their Alloys)** of **Metallography** edited by W. Guertler. Gebrüder Borntraeger, Berlin, 1935. Paper, 7 x 10¾ inches, 494 pages. Price 54RM.

This is the latest section (synonyms are much in demand for the description of the German method of subdividing handbooks) of Professor Guertler's famous *Metallographie*. The first volume, written by Prof. Guertler himself, appeared in 1912; since then additional volumes have appeared from time to time, now totalling 13. Metallography has developed so rapidly in this time—24 years—that the first and last volumes belong to different eras, and though the whole treatise is of unmistakable value, the long delay in accomplishing the full task has greatly diminished the usefulness of the work. There cannot be a "complete whole" here: one can hardly turn for information from the present volume on mechanical properties back to the first volume on the constitution of binary systems, published 24 years earlier, and obtain much satisfaction. Unless a comprehensive treatise of this sort appears complete within a reasonable time-period its effectiveness is largely lost.

These remarks should in no way detract from the admirable character of each of the separate volumes which have appeared. These volumes represent that pronounced German trait of completeness, of exhaustive bibliographic research so evident in the continual publication of important books,—a condition which makes the English-speaking metallurgist envious of the library facilities of his German colleague. Apart from the recent admirable effort of the Engineering Foundation in publishing the *Alloys of Iron Monographs* in this country, English publications on metallurgy have been sporadic and little given to meeting the needs of the trade or the profession.

The present book reflects the growing importance to the metallurgist of a knowledge of the elastic and mechanical properties of metals. Those happy days when a laboratory metallurgist needed only to be able to recognize alloy structures under the microscope, and to know only the elementary principles of heat-treatment, are unhappily past. The mechanical properties are obviously of first importance in determining fabricating procedure; metals and alloys are sold and used chiefly because of their mechanical properties (I have never heard of a sales manager ordering a thousand tons of martensite to conform in specifications to a photomicrograph!). This part of the science is growing rapidly and is now as important to the metallurgist as metallography in the old sense; it is surprising that the first serious attempt to organize this field was made as late as 1925 (G. Sachs. *Mechanische Technologie der Metalle*). In a rapidly growing science, the present volume, needless to say, is very welcome.

Burkhardt and Sachs have assembled from the literature pertinent information on the mechanical and technical properties of the pure metals. Each metal, with the exception of several groups like the platinum metals, is listed separately, with discussions of physical constants, degrees of purity (and, fortunately, sources of supply which as given are largely German), elastic constants, plastic behavior, and technical properties, including methods of melting, purification (only briefly), and fabrication. The data are given in a multitude of tables and diagrams, and photomicrographs are frequently used in illustration. True stress-strain diagrams are often used; X-ray photograms, and the prejudiced pole-figure and stereographic projection are presented to describe the plastic properties, particularly preferred orientations. Results on the study of single crystals are given when available, and the effect of grain size on physical properties described when possible; recovery and recrystallization phenomena are included.

It would be a difficult task to ascertain the completeness of the work,—an attempt was made to have it complete up to the beginning of the year 1934. Some lack of balance is evident: only 14 pages are devoted to Fe, whereas 16 are given to Ag and 63 to Zn! Kenyon's paper on Armco Fe is not included, nor is the work of Edwards and Pfeil on single crystals of Fe; I believe that Cioffi's work on pure Fe was reported in time for inclusion, though it does not appear. A more complete treatment of blue-brittleness and aging would be welcome, for all pure irons exhibit these phenomena. The sections on Cu, Al and Zn are very complete; much space is devoted to a discussion of the effect of impurities on the properties of Cu; space is often given to special topics pertaining to particular metals, such as hydrogen brittleness in Cu, desulphurization of Ni, and the allotropy of Fe.

This book is a valuable and needed addition to the metallurgical literature. So far as I know it is the only reference book available on the mechanical properties of the metals, and it can certainly be used to advantage by the metallurgist—if he will. The book will appear in better perspective when the comparison volume on the mechanical properties of alloys appears.

Robert F. Mehl (11) -B-

The Distribution of Molecules in a Model Liquid. W. E. Morrell & J. H. Hildebrand. *Journal of Chemical Physics,* Vol. 4, Mar. 1936, pages 224-227. By means of a 3-dimensional molecular assemblage the relative frequency of occurrence of the varying intermolecular distances of a liquid may be determined. The model simulates the expansive effect of temperature and by it a good approximation is obtained to the distribution of molecules in liquid mercury determined by Menke with X-ray diffraction methods. FPP (11)

On the "Permalloy Problem." J. L. Snoek. *Nature,* Vol. 137, Mar. 21, 1936, page 493. Studies on permeability by Lichtenberger, Dillinger and Bozorth, Yensen and Ziegler, and Ruder, may be correlated with Lichtenberger's theory for the high permeability of permalloy (78% Ni). Disturbing effects from magnetostriction and crystal anisotropy are a minimum at the permalloy composition. CSB (11)

Powder Metallurgy, Notes on the New Art. Charles Hardy. *Metal Progress,* Vol. 29, Apr. 1936, pages 63-67. Describes the growth and applications of powder metallurgy from its origin with metals too refractory for melting to the preparation of very high purity alloys with new possibilities and properties. WLC (11)

11a. Non-Ferrous

A. J. PHILLIPS, SECTION EDITOR

Niobium and Its Uses. L. Sanderson. *Sands, Clays & Minerals,* Vol. 2, Apr. 1936, pages 99-101. Cb, one of the rarer elements, is contained in columbite which is an end member of a series of niobates of Fe and Mn; [illegible] closely resembles Ta and melts above 1800° C. It is mainly used as electrode material in radio valves and as a "getter" in vacuum tubes; it has a larger electron emission than Mo at high temperatures. When used as alloying element in steel it is said to render the metal harder and tougher than other elements, and it acts also as scavenger, in a manner similar to V. The metal is produced by reduction from the ore and manufactured into bars, sheets, wires and rods, but very little has been produced. The principal compounds are CbH, CbO_2, Cb_2O_4, Cb_2O_3, Cb_2O_5 and CbF_5KF. Sp. gr. is 8.3. As a stabilizer of stainless steels, it retards intergranular corrosion, especially after long holding at 1000°-1500° F. Ha (11a)

Magnetochemistry of Rhenium (Sur la Magnéto-Chimie du Rhenium) Nicolas Perakis & Léandre Capatos. *Journal de Physique et le Radium,* Series 7, Vol. 6, Nov. 1935, pages 462-468. Metallic and heptavalent Re were each found to possess very feeble paramagnetism, independent of the temperature within the interval — 190° to + 25° C. The coefficient of susceptibility was found to be + .366 x 10^{-6}. FPP (11a)

Relative Rates of Diffusion of Hydrogen and Deuterium Through Heated Platinum (Etude Comparative des Vitesses de Diffusion de l'Hydrogène et du Deutérium a travers le Platine Chauffé) René Jouan. *Journal de Physique et le Radium,* Series 7, Vol. 7, Feb. 1936, pages 101-106. The rate of diffusion of deuterium through Pt heated to various temperatures between 450° and 950° C. was ¾ that of H, a difference so slight as to preclude use of such a process for separating a mixture of the isotopes into its constituents. FPP (11a)

Influence of Phosphorus and Sulphur Upon the Mechanical Properties of Platinum and Palladium (Der Einfluss von Phosphor und Schwefel auf die mechanischtechnologischen Eigenschaften von Platin und Palladium) A. Jedele. *Zeitschrift für Metallkunde,* Vol. 27, Dec. 1935, pages 271-275. The embrittlement of Pt and Pd by small additions of P and of Pd by S is verified while Pt is found to be little affected by S up to 0.15%. The systems Pt-P, Pd-P and Pd-S form low melting grain boundary constituents (Pt — Pt_7P_{20} eutectic melting at 588° C.; solid solubility 0.005% P) (Pd-P low melting eutectic; solid solubility about 0.01% P) (Pd_4S melting at 761° C.; solid solubility about 0.01% S) which are molten at ordinary hot working temperatures and cause hot shortness when the P or S is present in quantities greater than about half the limit of solid solubility. S dissolves in Pt at least up to 0.23% and increases the hardness but not the hot shortness within the range noted above. The ultimate strength (t.s.) in kg mm.², yield point, elongation (E) in %, and Brinell harness (BHN) of the following composition ranges were measured on rolled and drawn stock at room temperature:

Temp.	Composition range	Ten. str. range	Elong. range	Composition	B.H.N. range
Room	Pt-P .001-.96	14.8-25.9	27.1-2.75	.001-.96	45-145
Room	Pd-P .006-.265	22.4-28.2	23.1-19.5	.006-.93	60-135
Room	Pt-S .005-.15	15.3-19.9	24.7-14.7	.005-.23	45-93
Room	Pd-S .001-.32	19.4-29.5	24.2-17.2	.001-.92	50-90
850° C.	Pt-P .001-.003	6.9-4.2	9-6.2		
850° C.	Pd-P .001-.006	5.3-4.1	9.2-15.2		
850° C.	Pt-S .005-.15	5.3-8.7	14.5-5.8		
850° C.	Pd-S .001-.003	6.6-8.1	16.8-18.8		

FNR (11a)

Ferromagnetic Increase of Resistance of the Copper-Nickel Alloys (Ferromagnetische Widerstandserhöhung der Kupfer-Nickel-Legierungen) B. Svensson. *Annalen der Physik,* Series 5, Vol. 25, Feb. 1936, pages 263-271. The specific electric resistance of 9 different Cu-Ni alloys was measured between 0°-500° C. and a formula developed giving the ferromagnetic resistance as function of concentration. 11 references. Ha (11a)

Heat Emission of Polonium; Determination of Its Radioactive Constants by Calorimetric Methods (Le Débit de Chaleur du Polonium; Determination par Voie Calorimetrique de ses Constantes Radioactives) A. Saniélevici. *Journal de Physique et le Radium,* Series 7, Vol. 6, Feb. 1935, pages 73-77. Using an adiabatic microcalorimeter, measurement was made of the heat emitted during radioactive emanation of Po. FPP (11a)

Zirconium and Its Compounds. L. Sanderson. *Chemical Trade Journal & Chemical Engineer,* Vol. 97, July 26, 1935, page 75. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 411L/5. MS (11a)

The Plastic Deformation of Cadmium Single-Crystals. R. Roscoe. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, Feb. 1936, pages 399-406. Bending of monocrystal wires of Cd showed that, when the stress over the glide planes of a crystal is not uniform, slip begins when the max. value of the resolved shear stress reaches the critical value for deformation under uniform stresses. Surface oxidation of Cd monocrystals produces an increase in their resistance to plastic deformation which cannot be due to the cohesion of the oxide film; the added strength may be due to healing of submicroscopic cracks by the film. Ha (11a)

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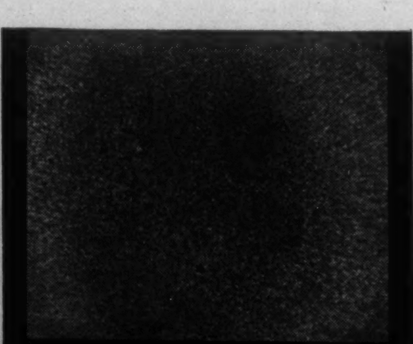

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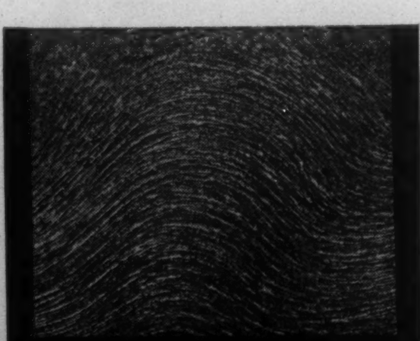

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Silumin. Metallgesellschaft, Frankfurt-am-Main, 1936. Paper, 8 x 12 inches, 56 pages.

Modified cast Al-Si alloys, first introduced by Dr. Pacz under the trademark "Alpax," are known in Germany as "Silumin." The basic alloy contains about 13% Si, but modifications containing small amounts of Cu and Mn are known as copper-Silumin, and alloys containing added Mg and Mn are known as Silumin-beta and Silumin-gamma. This booklet gives a summary of the physical and mechanical properties of these alloys, together with suggestions regarding casting, heat treatment, working and surface finishing. The book is attractively illustrated with photomicrographs, diagrams, art studies of casting and testing operations, together with a multitude of photographs of various articles formed from these alloys. J. D. Edwards (11a) -B-

Experiments on the Electrical Resistance of Copper and Some Copper Alloy Wires. C. Blazey. *Engineering,* Vol. 141, Mar. 20, 1936, page 320. Abstract of paper read before the Institute of Metals. See *Metals & Alloys,* Vol. 7, May 1936, page MA 257L/1. VSP (11a)

Non-Ferrous Alloys Available for the Use of Industry. High Tensile Bronzes and Brasses. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, page 300. Lists characteristics of Immadium II, III, IV, V, and VI, Crotorite IV and V, and Aluminium Bronzes Nos. 135 and 136, made by Manganese Bronze and Brass Co. JCC (11a)

Large Single Crystals of Cooper. Simplified Method for Their Preparation. J. G. Thompson. *Metals & Alloys,* Vol. 7, Jan. 1936, pages 19-21. 3 references. Describes preparation of single crystal of Cu large enough to machine into a 2.25" sphere by melting in a vertical Arsem furnace and slowly cooling the mass in the melting crucible from the bottom upward. WLC (11a)

Magnesium Silicide in 85-15 Brass. Effect on the Properties. H. S. van Klooster & J. E. Harris, Jr. *Metals & Alloys,* Vol. 7, May 1936, pages 135-139. Additions of up to 4.7% Mg_2Si to 85-15 brass shows increased hardness and decreased electrical conductivity with high Mg_2Si. Annealing tends to increase both properties up to about 500° C. No age hardening is observed. Hard particles of Mg_2Si scattered through the brass after prolonged annealing at high temperatures produce a structure of possible application as bearing metal. 8 references. WLC (11a)

Effect of Thallium on the Freezing Point of Indium-Lipowitz Alloy. Sidney French. *Metals & Alloys,* Vol. 7, Mar. 1936, page 64. Alloy of 81.9% Lipowitz metal and 18.1% In (m.p. 46.5° C.) was not reduced in m.p. by Tl additions but the sharpness of m.p. was reduced. WLC (11a)

The Effect of Thallium on the Freezing Point of Lipowitz Alloy. Sidney J. French & Donald Saunders. *Metals & Alloys,* Vol. 7, Jan. 1936, pages 22-23. 6% Tl produces alloy freezing at 66.6° C. or 3.1° C. lower than Lipowitz alloy. WLC (11a)

Elektron and Hydronalium Castings (Ueber Elektron- und Hydronaliumguss) P. Spitaler. *Giesserei,* Vol. 23, Apr. 10, 1936, pages 177-181. Certain conditions which should be observed when casting elektron metal (Mg alloy with Al) and hydronalium (Al alloy with 3-12% Mg) are discussed and explained. Al-containing Mg alloys obtain a much finer structure if the melt is overheated (to about 900° C.) which also influences castability and mechanical properties favorably. A certain manner of filling the mold is described which secures the dense structure. Hydronalium melts have a tendency to strong oxidation and formation of nitrides and dissolve H; by adding boric acid this tendency is largely reduced. Tables of mechanical properties for different compositions of both alloys are given. Ha (11a)

The Effect of Heat Treatment on the Structure of Gold- and Silver-Leaf. G. D. Preston & L. L. Bircumshaw. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, Apr. 1936, pages 713-727. Au and Ag leaves were heated in air, H and in vacuum and tested by the electron diffraction method with regard to eventual changes. A contraction takes place when Au leaf is heated in air to about 350° C. whereby recrystallization and reorientation of the crystals take place. These changes are absent in H at even higher temperatures and in vacuum. Similar effects are observed in Ag leaf but at lower temperatures. 10 references. Ha (11a)

Selection of Light Alloys for Aero Engines. J. R. Handforth. *Metal Treatment,* Vol. 2, Spring 1936, pages 3-13. This paper is remarkable for its comprehensive tables. Details are given of compositions and mechanical properties of all the principal American, British, and German wrought and cast Al alloys. In addition, the alloys chosen by 10 leading manufacturers for the principal nonferrous components of their aero engines are tabulated. Mg alloys are little used. Besides mechanical properties, it is often necessary when making a choice of alloy to consider such characteristics as anti-frictional properties at high temperatures, specific heat, thermal conductivity, and coefficient of thermal expansion. JCC (11a)

Production of White Metal Linings. Edmund R. Thews. *Canadian Chemistry & Metallurgy,* Vol. 20, Apr. 1936, pages 111-112. The strength, ductility, and frictional properties of the white metal liners are of no greater value than the adherence and compression strength. In applying a lining, a number of important points must be considered: the properties of the alloy used, composition and size of the bushings, the diameter of the shaft or journal, finish on the inside of the bushings, temperature of the bushing, the pouring temperature of the white metal and temperature of the shaft or journal, metal to metal adhesion, cleaning and etching, tinning the bearing, lining temperature, the effect of rate of cooling, and core conditions are discussed. The essential conditions in lining bearings with white metal are summarized as: (1) correct composition of the lining material, (2) proper preparation of the bearing surface, (3) correct cleaning and etching, (4) correct tinning, (5) rapid succession of etching, tinning and lining, (6) proper bearing and lining temperatures, (7) correct temperature of journal core, and (8) avoidance of vibration during cooling of lining. WHB (11a)

Photoelectric Effect of Aluminum Films Evaporated in Vacuum. E. Gaviola & John Strong. *Physical Review,* Vol. 49, Mar. 1936, pages 441-443. Sensitivity curves of Al films deposited by evaporation in vacuum have been determined. A new threshold value of 2830 A.U. and a selective maximum around 2700 A.U. have been found. The cell has the form of a horn, absorbing all the incident light. Charcoal was used for producing high vacuum and for giving off gases that influence the position and inclination of the sensitivity curves. WAT (11a)

Inconel (Inconel). R. Hanel. *Chemische Fabrik,* Vol. 9, May 13, 1936, pages 217-220. Chemical composition, physical and mechanical properties, corrosion resistance, heat resistance, workability hot and cold, foundry properties, heat treatment, surface finishing, welding, soldering and applications of Inconel are discussed and tabulated. The alloy contains 80% Ni, 14% Cr and 6% Fe, is resistant to many corrosive fluids, resists oxidation to 1100° C., is less susceptible to high temperature sulphur attack than Ni, and is used as castings, sheet, tubing, bars and rods. FPP (11a)

Endurance Limit of Aluminum Alloys (Limite d'endurance des alliages d'aluminium) R. Irmann. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 231-236. A general discussion. JDG (11a)

Atomic Weight of Gallium. G. E. F. Lundell & James I. Hoffman. *Bureau of Standards Journal of Research,* Vol. 15, Oct. 1935, pages 409-420. Preliminary tests showed that the metal was free from an appreciable film of oxide and did not contain occluded gases. The highly ignited oxide, obtained through the hydroxide or the sulphate, contained no gases and was not appreciably hygroscopic. The oxide obtained by igniting the nitrate was less satisfactory. To make possible the correction of the weights to the vacuum standard, the density of the oxide was also determined, and found to be 5.9 g./cm³. The value for the atomic weight based on this work is 69.74. WAT (11a)

Electrical Conductivity of Thin Films of Rubidium on Glass Surfaces. A. C. B. Lovell. *Nature,* Vol. 137, Mar. 21, 1936, pages 493-494. The conductivity of layers of Rb 1 to 10 atoms thick has been measured. Conductivity first becomes appreciable, with conditions of high purity and high vacuum in layers of ½ atom average thickness. CSB (11a)

Permeability of Pd to H_2. Effect of Temperature on Diffusion in Pure Pd. Regeneration of Contaminated Pd (Perméabilité du Palladium à l'Hydrogène. Perte du Pouvoir Diffusant du Palladium Pur sous l'Action de la Température. Régénération du Palladium Empoisonné) Victor Lombard, Charles Eichner & Maxine Albert. *Comptes Rendus,* Vol. 202, May 25, 1936, pages 1777-1779. Prolonged heating of Pd in H_2 at 500°-520° C. gives maximum penetration. Reheating in air at 500° C. with a subsequent heating in H_2 below 140° C. to reduce the superficial layer of oxide formed will restore the Pd to its original state. FHC (11a)

Photoelectric Effect of Pd-Ag Alloys Saturated with Hydrogen (Lichtelektrische Empfindlichkeit von Palladium-Silberlegierungen, die mit Wasserstoff gesättigt sind) F. Kruger & W. Kallenboch. *Zeitschrift für Physik,* Vol. 99, Apr. 14, 1936, pages 743-750. After 30 hrs. in H_2, an alloy with 20% Ag shows a maximum photoelectric effect and an alloy of 60-65% Ag the minimum effect. FHC (11a)

The Longitudinal Thermoelectric Effect: (6) Mercury. J. L. CH'EN & W. BAND. *Proceedings, Physical Society,* Vol. 48, Jan. 1936, pages 164-167. It is confirmed that the Benedicks e.m.f. in Hg contained in an unrestricted glass tube falls off with rise in temperature and is restored on cooling. It seems plausible to explain this by assuming that anisotropic liquid crystals exist in the liquid, their arrangement depending on temperature. JCC (11a)

Beryllium and Beryllium Alloys. M. G. CORSON & J. D. ZEISER. *Iron Age,* Vol. 137, Mar. 5, 1936, pages 28-32, 74. Reviews the history of Be, and the various alloys of Be are considered both from the technical and practical standpoint. The different properties of the alloys are listed and attention is focused on characteristics fitting the various alloys to specific industrial applications. Proper foundry practice is discussed in detail. Includes a table showing the characteristics of Ni-Be alloys of 1.7% Be. VSP (11a)

Study of Thermionic Emission of Salts Through Copper (Étude des Conditions de l'Emission Thermionique de Sels Diffusant a travers le Cuivre) J. CICHOCKI. *Journal de Physique et le Radium,* Series 7, Vol. 6, Sept. 1935, pages 397-400. Investigation of the thermionic emission of Cu sheet filled with alkaline halides revealed variations in work function explainable only by assuming the existence on the surface of the electrode of a monomolecular layer of alkali-metal atoms that had diffused through the Cu and combined with the Cu or its oxide. FPP (11a)

Skin Deep: Allowable Stresses in Stressed-skin Structures. JOSEPH S. NEWELL. *Aviation,* Vol. 34, Dec. 1935, pages 18-20. Based on Bureau of Standards Tests, formulae for calculating the maximum load carried by 17ST Aluminum Alloy flat sheets with V-groove edge supports are plotted and compared. FPP (11a)

Thermionic Electron Emission. J. A. BECKER. *Bell System Technical Journal,* Vol. 14, July 1935, pages 413-476. Comprehensive theoretical review which while mostly mathematical physics, contains information bearing on metallurgy of filament wire. Various crystals of a filament wire have different work functions and electronic emission. A compiled table giving values of the photoelectric and thermionic heat functions of many pure metals is given. HFK (11a)

Making and Testing Single Crystals of Lead. B. B. BETTY. *Proceedings American Society for Testing Materials,* Vol. 35, Part II, 1935, pages 193-203. Includes discussion. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 145L/1. (11a)

Non-Ferrous Nickel Alloys. L. M. ANGUS-BUTTERWORTH. *Engineer,* Vol. 161, Feb. 28, 1936, page 224. Brief article outlining the effect of heat treating on the properties of certain non-ferrous Ni alloys. By various heat-treating methods the alloys can be made either soft and ductile or hard and strong with high elastic properties. Heat treatment consists of softening by cooling rapidly from temperatures above 800° C. and hardening by reheating between 400° C. and 650° C. With the proper composition it is possible with one heating to obtain the combined effects of cold work, a strain-relief annealing and a hardening treatment. LFM (11a)

The Magnetic Transformation Point of Heavily Cold-worked Nickel. H. QUINNEY. *Journal Institute of Metals,* Vol. 55, No. 2, 1934, pages 229-245. Includes discussion. See "Some Properties of Heavily Cold-worked Nickel," *Metals & Alloys,* Vol. 5, Nov. 1934, page MA 535. (11a)

Plant-construction Materials. F. E. CARTER. *Chemical Trade Journal & Chemical Engineer,* Vol. 97, Aug. 16, 1935, page 140. See "Precious Metals as Materials of Construction," *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 411R/9. MS (11a)

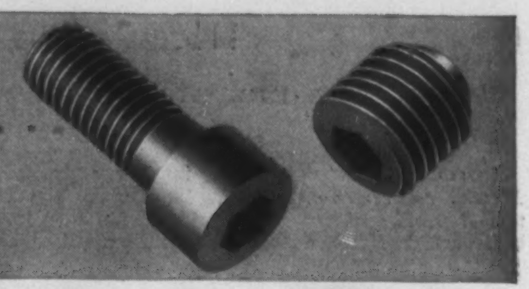
Non-ferrous Metals Handbook. Light Metals (Werkstoffhandbuch Nichteisenmetalle. Leichtmetalle, abschnitte G-K) Edited by G. MASING, W. WUNDER & H. GROECK. VDI Verlag, Berlin, 1936. Paper, 5½ x 8¼ inches, 174 pages. Price 13.50 RM.

Just as is the case with the "National Metals Handbook" of the A.S.M. the German handbooks are constantly being re-written and brought up to date. The Germans put the ferrous and non-ferrous data in separate handbooks. Their non-ferrous one is now out of print, and is being entirely re-written. All of the new edition is expected to be out during 1936 and 1937. The first section to be distributed is that on light metals. Most of the subsections in that section of the last edition were prepared in 1927. The 1936 edition of this section is some 25% larger. The heat-treatable alloys in particular are given more space than previously. Instead, as was often the case previously, of using German trade names as headings, those trade names, which have now become legion, are relegated to brackets below the main headings. The main divisions are pure Al, wrought alloys, cast alloys, and Mg and its alloys. The information is given in highly condensed form, with a selected bibliography after each subsection. With rare exceptions, the references are to German publications. It will be indispensable to German metallurgists, but the English-speaking reader, who will easily find the information he is after when only sketchy data are wanted, will have difficulty in chasing down the details when more comprehensive information is sought. H. W. Gillett (11a) -B-

Physical Properties of Babbitt, Tin Base Bearing Alloys. OWEN W. ELLIS. *Metal Progress,* Vol. 29, Feb. 1936, pages 56-59. Discusses the effects of various additions such as Zn, Al, Bi, Pb and Cd on various properties of Babbitt metal (Sn-Sb-Cu). Wear, fatigue, hot strength and hardness tests indicate that Cd improves these properties up to 1% Cd. WLC (11a)

The Physical Properties and Annealing Characteristics of Standard Nickel-Silver Alloys. MAURICE COOK. *Engineering,* Vol. 141, Mar. 20, 1936, page 320. Abstract of paper read before the Institute of Metals. See *Metals & Alloys,* Vol. 7, May 1936, page MA 258R/1. VSP (11a)

The Thermomagnetic Properties of Nickel. Part 2. WILLIAM BAND & Y. K. HSÜ. *Proceedings, Physical Society,* Vol. 48, Jan. 1936, pages 168-177. Determinations of the homogeneous thermoelectric e.m.f. in a Ni wire 1 mm. in diameter for various tensions up to 8 kg. are recorded and analyzed. It is suggested that the effect is controlled by the regularity of the arrangement of microcrystals within the wire. JCC (11a)



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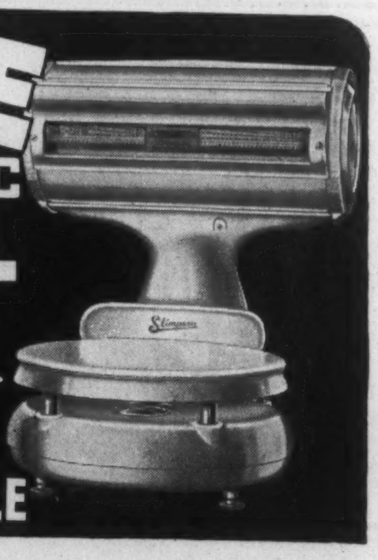

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11b. Ferrous

V. V. KENDALL, SECTION EDITOR

Oxygen and Oxides Segregate in Reverse to Sulphur. ALBERT PORTEVIN. *Metal Progress,* Vol. 29, Mar. 1936, pages 65-66. Reports studies of segregation of O_2 in steel and suggests that, unless the location of the sample taken for O_2 analysis is known, erroneous conclusions may be drawn. WLC (11b)

Grain-Size and Its Influence on Surface Decarburization of Steel. D. H. ROWLAND & CLAIR UPTHEGROVE. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 96-132. Report of study of decarburization of C steels of 0.71-1.07% C. Data indicate that coarse grain steels lose more C than fine-grained under the same conditions. Time and temperature effects on character and depth of totally decarburized zone for both types of steel are reported. Relative widths of ferrite bands on coarse and fine grained steels are independent of time. Maximum depth of carburization at A_3 point of steels investigated is reported. Data are submitted in support of the theory that columnarization of ferrite between 1290°-1650° F. results from γ to α phase change. A theory is advanced for columnarization below A_1 point. Explanation of the mechanism of decarburization is reached from study of gas analysis of products of decarburization. 15 references. WLC (11b)

Choosing a Composition for Low-alloy High-strength Steel. S. EPSTEIN, J. H. NEAD & J. W. HALLEY. *Metals Technology,* Apr. 1936, *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 697, 31 pages. Steels were studied with the object of finding a composition that would give a yield strength of about 60,000 lbs./in.^{2}, a tensile strength of 75,000 lbs./in.^{2}, good ductility, formability approaching that of a C steel, and good weldability. The steel should have these properties in the as-rolled condition and should not require any special heat treatment. The literature is reviewed and summarized with reference to the effects of C, Mn, Si, Ni, Cr, Cu and P on the properties. The chosen composition was 0.10% max. C, 0.50% Mn, 0.12% P, 0.13% Si, 0.47% Ni, and 1.05% Cu. It was found that Cu, Ni and P increase yield strength more rapidly than tensile strength, whereas the other alloying elements increase tensile strength more rapidly than yield strength. Yield strength is considered of major importance in design. Tensile properties, bending properties, impact, hardness and weldability of the steel of the chosen composition are reported. Tensile and impact tests were made on welded specimens. 32 references. JLG (11b)

Some Alloys of Copper and Iron. The Tensile, Electrical and Corrosion Properties. EARLE E. SCHUMACHER & ALEXANDER G. SOUDEN. *Metals & Alloys,* Vol. 7, Apr. 1936, pages 95-101. Study of electrical and mechanical properties of 75%-37.5% Cu-Fe alloys shows little segregation in ¾" and 1" bars cast 20" long. All compositions hot worked satisfactorily from this size to 0.25" rod. Optimum combination of electrical and mechanical properties is found in 50-50 alloy aged at 500° C. before hard drawing which shows in 18 AWG a tensile strength of 180,000-190,000 lbs./in.^{2} and a conductivity 30% that of pure Cu. 19 references. WLC (11b)

Alloys of Copper and Iron. K. M. SIMPSON & R. T. BANISTER. *Metals & Alloys,* Vol. 7, Apr. 1936, pages 88-94. Reports study of hot and cold working properties of 25 and 50% Cu alloys of Fe. Physical property values are reported and it is stated that the alloys can be produced in wire, sheet, rod and seamless tubing. Effects of C and Cr on separation of 2 liquid phases and effects of Ni and Cr on corrosion resistance are discussed. In production of castings of ingots of the alloys proper feeding must be provided to take care of the large solidification shrinkage. 8 references. WLC (11b)

Note on Annealing Twins in Ferrite. ALLAN L. TARR. *Metals & Alloys,* Vol. 7, May 1936, page 130. Shows micrographs of annealing twins in Armco iron. WLC (11b)

The Role of Copper in Wrought Steel. CLYDE E. WILLIAMS & CLARENCE H. LORIG. *Metals & Alloys,* Vol. 7, Mar. 1936, pages 57-63. Cu increases yield strength with greater effect than C with less loss of toughness. Significant table shows the following in 3 steels having tensile strength of 100,000 lbs./in.^{2} in a normalized condition:

C content	0.47%	0.33%	0.20%
Cu content	0.00	1.00%	2.00%
Yield strength lbs./in.^{2}	60,000	67,000	80,000
Red. of area %	47	54	61
Elong. in 2 in. %	26	28	28
Brinell hardness	188	195	196

WLC (11b)

A Dilatometric Study of the Alpha-Gamma Transformation in High Purity Iron. C. WELLS, R. A. ACKLEY & R. F. MEHL. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 46-74. Paper and discussion from Chicago Convention of the Society, 1935. Fe used was prepared from selected Armco and carbonyl Fe by prolonged treatment in H_2 at high temperatures (1200°-1500° C.) for from 47-500 hrs. Vacuum-melted electrolytic Fe also studied. Chemical and spectroscopic analyses show high purity for carbonyl Fe. Dilatometric and thermal curves show agreement. Purest Fe samples show Ac_3 point independent of rate of heating and inferior purity samples show dependence upon rate. Rates of ⅛, ½ and 2° C./min. were used. 16 references. WLC (11b)

Martensite and Austenite in Hardened Steels. Their Transformation Temperatures. BENGT KJERRMAN. *Metals & Alloys,* Vol. 7, May 1936, pages 127-129. Reports measurements of electrical resistance of quenched steel while being tempered which indicate that tetragonal martensite can be transformed to cubic form at temperatures as low as 40° C. Austenite does not appear to begin to decompose until all the martensite has changed but starts at about 180° C. and is complete at 240° C. when long times are employed. See also *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 74R/9. WLC (11b)

Basic Electric Steel from "Masa" Magnetic Sand. TOYOZO ISHIGAKI. *Suiyokwai-shi,* Vol. 8, Mar. 30, 1936, pages 957-990. The "Kokusan-Kogyo" Co. (Domestic Industrial Co.) is producing basic electric steel from "masa" magnetic sand (pure magnetic sand) of Izumo and Hoki districts in Japan. The manufacturing process is unique to the Japanese. The steel produced by this method not only has good mechanical properties but also does not give rise to abnormal structure when carburized. The specimens of these specially produced steels and other steels from ordinary processes were chemically analyzed, especially for their O contents according to the Petersen process. The impact values of the specimens were also determined after suitable heat treatment. The impact value varies considerably among specimens manufactured by different processes. A careful examination of the relation between the impact value and the chemical composition leads to the conclusion that, C content in all the specimens remaining constant, the largest impact value was manifested by the basic electric steel only from "masa" magnetic sand and the value decreased in the order of basic electric steel from the mixture of the "masa" magnetic sand and steel scrap, Swedish acid open-hearth steel, and basic open-hearth steel, and it is due to their progressively increasing O content. HN (11b)

On the Elastic Constants of Single Crystals of Iron. REN'ITI KIMURA & KAICHI OHNO. *Kinzoku no Kenkyu,* Vol. 13, Mar. 1936, pages 99-102. In Japanese. From Young's modulus of elasticity E and the modulus of torsion n in various directions, the Voigt moduli were found for monocrystal Fe at room temperature. The results are as follows: $S_{11}.10^{12} = 0.765$, $S_{12}.10^{12} = -0.289$, $S_{44}.10^{12} = 0.895$; $E_{[111]} : E_{[100]} = 2.06$, $n_{[111]} : n_{[100]} = 1/1.90$. These values are all given in c. g. s. units. KT (11b)

Measurement of Specific Heat of Iron at High Temperatures (Die Messung der spezifischen Wärme von Eisen bei hohen Temperaturen) K. MELISS. *Archiv für das Eisenhüttenwesen,* Vol. 9, Oct. 1935, pages 209-212. The specific heat of Fe with 0.06% C was determined in a water calorimeter by the method of mixtures. A method is described for correcting for heat losses of the specimen on transferring from the furnace; the magnitude of the experimental errors was within 0.1%; the precision within 0.05%. The heat content of Fe over the temperature range 600° C. to 1250° C. is shown in a curve. SE (11b)

Tensile Properties and Corrodibility of High-Tensile Steels (Festigkeitseigenschaften und Korrosionsverhalten von Hochbaustählen) E. MAURER & H. HEINE. *Archiv für das Eisenhüttenwesen,* Vol. 9, Jan. 1936, pages 347-357. Tension and fatigue tests of various high-tensile German and American structural steels were made of smooth and notched bars, in air and under water, and after weathering, aging, and hardening. No significant differences were found between the steels, nor between those made with scrap-C practice and pig Fe-scrap practice. SE (11b)

Correlation of Failures from Embrittlement of 4-6 Per Cent Chromium Steel with Notched Bar Impact Test. H. M. WILTEN. *Transactions American Society for Metals,* Vol. 23, Dec. 1935, pages 915-967. 15 references. Discussion containing 25 additional references. Addition of 0.50% Mo to this steel prevents embrittlement as shown by both laboratory and service results. Similar data are covered in abstract of Low Alloy steel for Oil Refinery Service, R. L. Wilson, *Metal Progress,* Vol. 28, Sept. 1935, pages 29-33 (see *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 204R/1). WLC (11b)

Properties of the 9% Chromium Steel (an intermediate alloy). H. D. NEWELL. *Metal Progress,* Vol. 29, Feb. 1936, pages 51-55. Describes development of 9% Cr, 1.50% Mo steel for moderately severe corrosive and oxidizing service up to about 1250° F. The composition specified is C 0.15% max., Mn 0.50%, max., Si 0.50% max., Cr 8.0-10.0%, Mo 1.25-1.75%. Tubes of this alloy will show physical properties over 75,000 lbs./in.^{2} tensile strength, 30,000 lbs./in.^{2} yield point, 30% elongation in 2 in. and Brinell of 180 max. Creep properties are reported as follows:

	900° F.	1000° F.	1100° F.	1200° F.
	lbs./in.^{2}	lbs./in.^{2}	lbs./in.^{2}	lbs./in.^{2}
0.10% in 1000 hrs.	33,250	11,650	6,950	2,300
0.01% in 1000 hrs.	24,750	5,800	3,775	1,600

WLC (11b)

Stainless Steels. H. BULL. *Aircraft Engineering,* Vol. 8, Feb. 1936, pages 51-54. A survey of the development of straight Cr and 18-8 steels. Weld decay is discussed and micros of failures shown. Considerable data are given in tabular form of physical properties and corrosion-endurance properties of the steels with various heat treatments. Effect of various temperatures is shown in tabular data on toughness determinations by means of impact tests. The solution to problem of development of 2-phase steel immune to weld decay is to produce a weld-decay free material containing a minimum of the 2nd constituent in order to prevent brittleness. Most recent development is addition of 3-4% extra Ni with 1.5-2.0 Si which gives corrosion resistance almost up to usual Ni content with 3½ Mo and without the usual brittleness. Some creep values for 538°-815° C. are tabulated. WB (11b)

Recent Developments Affecting Testing Society's Specifications for Steel Castings. R. A. BULL. *Metals & Alloys,* Vol. 7, Jan. 1936, pages 1-4; Feb. 1936, pages 35-38; Mar. 1936, pages 65-68. Discusses increased number of A.S.T.M. specifications for steel castings. Factors to be relied upon in the use of steel castings are metallurgically good casting design, proper grade of steel, dependability of available sources of supply and laboratory tests known to give reliable data on serviceability of castings in question. Mass effects in solidification and heat treatment are discussed as they affect the properties of castings. WLC (11b)

Electrical Resistivity of Faraday Steels; Gas Analysis and New Phenomena on Remelting in Radiation Furnace. CARL BENEDICKS. *Iron & Steel Institute,* May 1936, Advance Copy No. 5, 20 pages. Electric resistance of some of Faraday's steels were determined with equipment suitable for small specimens of irregular size. In 3 cases, where the electric resistance had been determined by other methods, the agreement was satisfactory. The influence of different elements on resistivity is discussed. Samples were melted in a radiation furnace and the occluded gases analyzed. Sharp corners on the specimens showed a high resistance to melting. On heating in a high vacuum pure Fe did not wet the Al_2O_3 crucible while C steels did. The difference is attributed to slight chemical reaction taking place on melting C-containing alloys. JLG (11b)

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12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

Alloys Which are Strong and Non-oxidizable at High Temperatures (Alliages tenaces et inoxydables aux temperatures elevees) P. Chevenard. *Chaleur et Industrie,* Vol. 17, Apr. 1936, pages 125-127. Paper read at the 4th Séance d'études thermiques, Dec. 1935. Methods used at the Aciéres d'Imphy for measuring creep rate, weight increase due to oxidation, and tendency to crack under cycles of heating and cooling are described. Creep limit is taken as the load which produces a mean elongation on unit length of 0.5 x 10^{-5}/hr. between the 25th and 35th hours. Typical creep rate-temperature curves are given. Strength at high temperature is shown by (1) steels with a depressed transition point such as Cr-Mo, Ni-Cr-Mo, Cr-Mo-V. These are good between 500° and 550° C., but softening effects of accidental overheating or overloading must not be overlooked; (2) complex solid solutions, usually with Ni-Fe-Cr base. These need stabilizing before use, for deformation accelerates the precipitation of carbides; (3) definite compounds, such as the sintered carbides; (4) age-hardening alloys, which should be used at temperatures below that at which precipitation occurs. Increase in the electrical resistance is used to measure the onset of cracking in samples repeatedly quenched from a high temperature. Ferritic alloys, low in C, strengthened by Cr, Cr-Si, or Cr-Al are least susceptible to cracking, and a richer alloy with 30 Cr and 5-6 Al may be used up to 1250°-1300° C. Cast irons with Cr or Mn have good non-scaling properties but lack strength. The complex Ni-Fe-Cr alloys containing Si, W, Al or Co developed at Imphy are recommended for general use, particular emphasis being placed on their stability when properly heat treated.
JCC (12)

Abbreviated Determination of Creep Strength at Variable Temperature (Abgekürzte Bestimmung der Dauerstandfestigkeit bei veränderlicher Temperatur) Max Schmidt & H. Krainer. *Mitteilungen des technischen Versuchsamtes Wein,* Vol. 24, 1935, pages 5-20. The behavior of materials under tests for creep strength is discussed and theoretically investigated which leads to a new method by Rohn. The method requires taking into account eventual sources of error due to irregular temperature distribution in the specimen and change of elasticity modulus with temperature, but as it is found that velocity of elongation and reciprocal absolute temperature have a linear relation the tests can be made in 30-48 hrs. The method is illustrated by measurements on 7 types of steel. 17 references.
Ha (12)

Standardization of Creep Testing of Steel (Vereinheitlichung des Dauerstandversuchs mit Stahl) H. Schmitz. *Stahl und Eisen,* Vol. 55, Dec. 19, 1935, pages 1523-1535. A correlated abstract giving also the recommendations of the Verein deutscher Eisenhüttenleute for creep testing. The sample should be at least 100 mm. long; the temperature over the gage length should be held constant within ± 3° C. The elongation should be measurable to 0.001% of the length. The load is applied for 45 hours after a preliminary heating period of 18 to 22 hours. 3 to 5 samples should be used with increasing loads for determining the creep limit. The rate of creep between the 25th and 35th hour is then measured, the creep limit being taken as the load which gives a rate of creep of 0.001%/hr. The total elongation after release of load also should not exceed 0.2% in 45 hours.
SE (12)

The Embrittlement of High-tensile Alloy Steels at Elevated Temperatures. W. E. Goodrich. *Iron & Steel Institute,* May 1936, Advance Copy No. 7, 17 pages. Alloy steels in the form of rounds from 1⅛" to 2" in diameter were heat treated to a tensile strength of approximately 145,000 lb./in.^{2} They were then tested to determine the effects on their Izod impact resistance of soaking at 200° and 450° C. for various periods up to 2400 hr. The effects of a constantly applied stress of 25,000 lb./in.^{2} during soaking, of intermittent temperature fluctuations from 450° to 100° C., and of the presence of initial strain were also studied. These treatments had no effect over and above that of soaking for the same period without stress or temperature fluctuation. A mildly alloyed steel with 0.6% Cr and 0.5% Mo had the greatest resistance to embrittlement. The higher the Ni and Cr contents of the steels the greater was the amount of Mo required to insure relative freedom from embrittlement. An increase in the Ni content decreased resistance to embrittlement of steels containing Cr and Mo. When comparing steels of almost the same composition samples tempered at the highest temperature had the greatest resistance to embrittlement at 450° C. All samples embrittled by heating for 2400 hr. at 450° C. exhibited a temper-brittle impact fracture, the path of rupture being partly intercrystalline. Soaking for 2400 hr. at 450° C. had practically no effect on Brinell hardness. Embrittlement was more pronounced at 450° C. than at 200° C. except for one Cr-Mo steel.
JLG (12)

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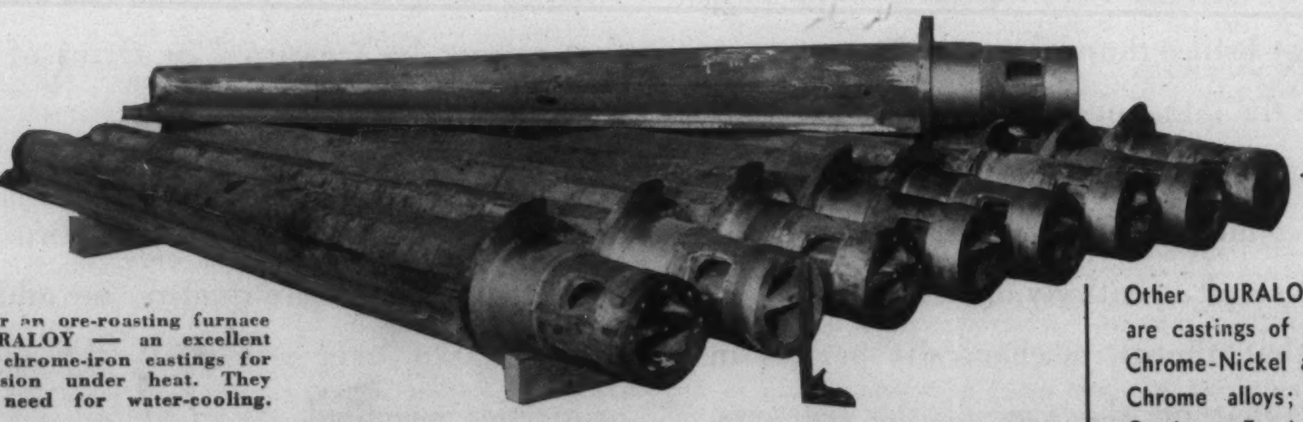

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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

Corrosion-Protective Value of Electrodeposited Zinc and Cadmium Coatings on Steel. William Blum, Paul W. C. Strausser & Abner Brenner. *Bureau of Standards Journal of Research,* Vol. 16, Feb. 1936, pages 185-212. Atmospheric exposure of plated specimens in 6 locations showed that in a rural or purely marine climate, both Zn and Cd coatings furnished better protection against the corrosion of steel than did Ni or Cr coatings of the same thickness, although the Zn and Cd rapidly lost their luster. In an industrial atmosphere, where H_2SO_3 and H_2SO_4 are present, both Zn and Cd were attacked rather rapidly, and the life was about proportional to the thickness. Under these conditions the Cd coatings failed in about ⅔ of the time required for failure of Zn coatings of the same thickness. Zn-Cd alloys containing about 10% Cd were superior to either Zn or Cd. Variations in the conditions selected for depositing the coatings did not have a marked effect on their protective value. Hot-dipped Zn coatings gave about the same protection as plated Zn coatings of the same thickness. In accelerated tests, such as the salt spray or intermittent immersion in a solution of NaCl, the time required for failure of a Zn coating is about proportional to its thickness. Cd coatings last much longer than those of Zn in a salt spray, which is not, therefore, a true measure of their relative value in an industrial atmosphere. The protective value of a Zn or Cd coating depends principally upon its minimum thickness, which can be determined by dropping tests, microscopic measurements, and the chord method. WAT (13)

Investigations on the Use of Aluminum in Glue Factories (Untersuchung über die Verwendung von Aluminium in Leimfabriken) *Aluminium,* Vol. 17, Dec. 1935, page 651. Al of at least 99.8% purity proved to be resistant as material in the apparatus used in glue factories, boilers, dryers, vaporizers and cooling coils, either entirely of Al or built into vessels of rustless steel. If the purity is lower (99.5%), however, the Al was corroded as the glue often contains SO_2 (about 0.4 g./kg.). These experiences were obtained in 10 French factories. Ha (13)

Research Work on Corrosion in the United States. *Engineering,* Vol. 141, Jan. 3, 1936, pages 8-9. Summary of the material contained in the reports of the four Corrosion Committees published recently by the American Society for Testing Materials. LFM (13)

Tantalum Resists Corrosion in Fountain Pen Valve. *Product Engineering,* Vol. 7, Feb. 1936, page 46. Ta resists corrosion both from ink and from contact with rubber compounds. Ha (13)

Studies on the Oxidation of Metals. Part III. The Kinetics of the Oxidation of Molten Tin. L. L. Bircumshaw & G. D. Preston. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, Mar. 1936, pages 686-697. The rate of oxidation of molten Sn was measured at different temperatures and pressures of O. The rate rises rapidly in the range 400°-800° C., but at any particular temperature the rate was found to vary considerably from one specimen to another. The law of oxidation for solid metals seems not to be obeyed for molten Sn, especially at low and high pressures of O. It is concluded that the rate of oxidation is not solely controlled by the progressive increase in the oxide film thickness but is determined rather by the orientation of the crystals composing the oxide film. 6 references. Ha (13)

Remarkable Defects in Boilers (Beachtenswerte Schadenfälle an Dampfkesseln) Beckmann. *Die Wärme,* Vol. 58, Sept. 28, 1935, pages 632-634. An extract from the Annual Report of the Sächsisch-Thüringischer Dampfkessel-Revisionsverein details break-downs and defects of boilers and endeavors to bring out the source of trouble. EF (13)

Factors Contributing to Ring Wear. J. H. Ballard, S. Nixon & N. A. Moore. *Diesel Power,* Vol. 13, Feb. 1935, pages 84-86. The importance of piston ring wear as affecting the engine life is stressed. To date attempts to translate Amsler wear tests into service performance predictions have been unsuccessful. Under ideal service conditions commercial cast Fe piston rings may survive thousands of miles, but actual conditions are not ideal; wear factors to be considered are: foreign matter and abrasives, limitations of engine design and manufacture, lubrication characteristics, abuse of engines, and "blowby." The last named is most important and is closely related to distorted bores, misaligned rods, etc. and general engine design. FPP (13)

Thermomagnetic Study of the Heterogeneity of Solid Solutions (Etude Thermomagnetique de l'Heterogeneité des Solutions Solides) Pierre Chevenard. *Communications Presentées à Quatorzième Congrès de Chimie Industrielle,* Vol. 1, Oct. 21-27, 1934, 19 pages. Thermomagnetic analysis permits a delicate and quantitative evaluation of the phenomenon of heterogeneity in a ferromagnetic solid solution. The study includes an enumeration of the different factors in the phenomenon and the effects of the heterogeneity on the alloy. The author studied especially the effect on complex ferronickels resistant to intercrystalline corrosion, and of structural hardness, that is, resistance to heat and cold. At ordinary temperature the elastic limit exceeds 50 kg./mm.^{2}, and tensile strength 100 kg./mm.^{2} In alloys with additions of Cr, Al, Mo, and Ti, the constituent which is precipitated does not appear in the austenitic solution. Likewise, the hardness should not affect the chemical resistance. The immunity of these alloys to intercrystalline corrosion, which has been proven theoretically, is confirmed by these tests lasting 6000 hours. MAB (13)

The Deterioration of Colliery Winding Ropes in Service. S. M. Dixon, M. A. Hogan & S. L. Robertson. *Safety in Mines Research Board (Great Britain)* Paper No. 94, 1936, 108 pages. The results of observations and tests on nearly 250 ropes, 85 of which had broken, are summarized, and the types of deterioration classified. Corrosion-fatigue is the chief cause of rope deterioration. Methods of preventing breakages, types of ropes, their manufacture and properties, and the effect of different factors in the winding conditions on the endurance of the rope are discussed. AHE (13)

Experiences on the Maiden Voyage of S. S. "Potsdam" (Erfahrungen auf der Jungfernreise der "Potsdam") Bleicken. *Werft, Reederei & Hafen,* Vol. 17, Jan. 1, 1936, pages 1-4. A chapter of this paper reports on the failure of the condenser system on the new express liner on its maiden voyage. Al brass with 76% Cu, 22% Zn and 2% Al was used for the condenser tubes. The same material yielded a perfect record during 8 years service on other ships. The defects were primarily due to the faulty design, especially joining methods. The softening of the boiler water with Na phosphate and Na sulphite is indispensable for the formation of a protective lining in the boiler tubes to prevent corrosion defects due to free oxygen. WH (13)

Report on Protective Coatings for Underground Pipes. A. B. Densham & F. C. Smith. *Engineering,* Vol. 140, Nov. 15, 1935, page 523. From a paper read before the Institution of Gas Engineers, Nov. 1935. For protection against external corrosion of underground pipes it was found that pitch troughing or a pitch or bituminous coating reinforced with fabric was the most satisfactory. Bituminous paints and various adhesive bandages were found to be unsatisfactory. There was very little difference between the resistance of wrought iron and steel pipes to corrosion. It was found that an electrical resistance test gave a good measure of the power of a protective coating. LFM (13)

The Electric Currents Flowing Over Rusting Iron. U. R. Evans. *Nature,* Vol. 136, Nov. 16, 1935, page 792. During the corrosion of a horizontal Fe surface by a filter paper wet with $NaHCO_3$ solution it was possible to measure electric currents flowing horizontally through the paper. Non-polarizing electrodes touching the filter paper and connected to a micro-ammeter were used. Moving these over the surface in the neighborhood of a scratch intense anodic action was found immediately around scratch where corrosion was rapid. Cathodic areas were free from attack. Isolated rust spots on steel were found to be anodic. Confirms theories of electrochemical mechanism of corrosion. CSB (13)

Study of the Phenomena of the Abnormal Corrosion in Condenser Tubes. Kurazo Fukagawa & Kenichio Kamiyama. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 14, Dec. 1935, pages 1241-1261. In Japanese. *Scientific Papers & Abstracts Institute of Physical & Chemical Research, Tokyo,* Vol. 28, Dec. 1935, page 73. In English. An inquiry into the abnormal corrosion of condenser tubes used in electric plants at the Setouchi sea-shore and on steamboats. The 4 different corrosion conditions observed have been imitated in laboratory experiments whereby Admiralty brass was used as testing material. WH (13)

Subcutaneous Effects During the Scaling of Steel. R. Griffiths. *Engineering,* Vol. 140, Oct. 4, 1935, pages 378-379. From a paper read before the Iron & Steel Institute, Sept. 1935. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 80R/8. LFM (13)

Recent Developments in the Use of Copper Pipe for Gas Distribution. F. A. Hough. *American Gas Journal,* Vol. 144, Jan. 1936, pages 31-33, 41. Conclusions from an earlier paper (1932) still appear valid. New evidence concerning the corrosion resisting properties of Cu is presented. Over 100 miles of Cu pipe have been installed in Southern Calif. with satisfactory results. The soils include adobe, alkali bottoms, salt marshes and submarine crossings. Cost data are also discussed. CBJ (13)

Anodic Behavior of Corrosion- and Heat-resistant Iron Alloys (Untersuchungen über das anodische Verhalten von Korrosions- und hitzebeständigen Eisenlegierungen) L. Harant. *Berg- und Hüttenmännisches Jahrbuch,* Vol. 83, Dec. 23, 1935, pages 122-127. Process of solution of anodes of different corrosion-resistant alloys in H_2SO_4 and HNO_3 was studied. Steels of approximately similar composition and structure showed also a great similarity in the dissolving process. After the passive state has been reached the solubility depends on the current density applied; at an average density there exists a sharply defined zone of perfect solubility, where all constituents of the steel dissolve in the same proportion in which they are contained in the steel. In the passive state and at the higher current densities the carbide C is oxidized so that the carbides are also dissolved. Curves show anode potentials as function of current density. 8 references. Ha (13)

Investigation into the Wear of Parts for Motor Vehicles (Untersuchung über die Abnutzung von Kraftfahrzeugteilen) F. Hanft. *Automobiltechnische Zeitschrift,* Vol. 39, Jan. 10, 1936, pages 9-19. Statistical data are compiled on the wear of parts in automobiles with time and of different materials. 15 references. Ha (13)

Test Comparative Values of Worm Gear Materials. Chester B. Hamilton, Jr. *Inco,* Vol. 13, No. 3, 1935-36, page 20. Tests with several materials for worm gears were made. A chill-cast Ni-P bronze of 87.5% Cu, 11% Sn, 1.5% Ni and 0.1 to 0.2% P was found to rank first in resistance to wear and deformation. The tests are briefly described. Ha (13)

Oxide Film of Alloys Containing Small Percentage of Aluminum. Ichiro Iitaka & Shizuo Miyake. *Nature,* Vol. 136, Sept. 14, 1935, page 437. Cu alloys containing more than 2% Al heated to red heat formed no oxide scale in several hours. The surface of a 10% Al alloy heated in contact with air blackened and gave the electron diffraction of CuO while the surface imbedded in the oxidizing flame of the Bunsen burner gave the electron diffraction pattern of γ-Al_2O_3. CSB (13)

Fight Against Corrosion in Duralumin (La Lucha contra la Corrosion en el Duraluminio) J. Lisbona. *Metalurgia y Construccion Mecanica,* Vol. 1, Jan. 1936, pages 9-10. Chemical and physical properties of duralumin (usually very pure Al with 4% Cu, 0.6% Mg and 0.6% Mn) are briefly discussed and means of protecting the surface against corrosion by anodic oxidizing treatment or coating with paint or artificial layers (of phenol, piridine, nitrocellulose, etc.) described quite generally. Ha (13)

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The Influence of Light on the Electrode Potential and Corrosion Phenomena of Mild Steel. C. O. Bannister & R. Rigby. *Iron & Steel Institute,* May 1936, Advance Copy No. 3, 7 pages. Previous work is reviewed. An apparatus was used in which perfect control of O was possible. In the absence of O light had very little influence on the potential. With O a marked response to illumination was shown. During the first 2 days the illuminated electrode became more cathodic and during the second 2 days it became more anodic. Probable mechanism of the reactions is given and the results are compared with those obtained with non-ferrous metals. 6 references. JLG (13)

Solubility in Acid and Corrosion Resistance of Unalloyed Structural Steels (Saurelöslichkeit und Rostungsverhalten von unlegierten Baustählen) K. Daeves & F. Eisenstecken. *Stahl und Eisen,* Vol. 56, Apr. 2, 1936, pages 417-418. Acid solubility tests were made of a series of low-C structural steels according to the French method. In this a disc 3 mm. thick and 55.7 mm. in diameter is held 48 hrs. in a 30% solution of H_2SO_4 at 15°-18° C. and the loss in weight determined. The results were compared with those of atmospheric corrosion tests of the same steels. The conclusion was drawn that the acid solubility tests give no indication whatever of service behavior under ordinary corrosion conditions or any conditions other than that of acid solubility in the strength acid used. SE (13)

Wire Rope Research in Relation to Colliery Practice. M. A. Hogan. *Iron & Coal Trades Review,* Vol. 132, Apr. 10, 1936, pages 665-666; Apr. 17, 1936, page 714. The serious effects of corrosion and fatigue on ropes in mining service are discussed. There occur 2 types of wear, abrasive and plastic, the former, easily visible, by which metal is removed from the surface without changing the character of the remaining part; plastic wear, when the surface is deformed and caused to flow under heavy pressure and becomes brittle. The different reasons for fatigue and corrosion fatigue which is particularly dangerous in conjunction with internal corrosion, are explained. Factors of safety, rope examination and mechanical testing are described. Ha (13)

Factors Influencing the Rate of Attack of Mild Steels by Typical Weak Acid Media. T. P. Hoar & D. Havenhand. *Iron & Steel Institute,* Advance Copy No. 9, May 1936, 27 pages. Corrosion rates and electrolytic potentials of low-C (mostly rimmed) steels were determined in citric acid and citrate buffers. Corrosion decreased as pH increased from 1.98 to 4.98. In the more acid solutions corrosion was accelerated by S in the metal or in solution. The acceleration was attributed to stimulation of the anodic process by dissolved sulphides. Corrosion was retarded by Sn and Cd ions, which removed soluble sulphide, and by Cu in the metal, which probably also removed sulphides. Massive cementite in the steel may accelerate corrosion by assisting the cathodic process. In less acid solutions all of these effects are diminished and O becomes an important factor. Necessity of electrochemical measurements for a real understanding of the processes is emphasized. It is suggested on the basis of the work that steel for use under conditions of acid corrosion, such as the base of tin plate, should preferably be rimming steel having a Cu content not less than twice the S content. JLG (13)

Aluminum Stringer Failures Due to Fatigue Loading. Henry D. Johnson, Jr. *Engineering News-Record,* Vol. 116, Feb. 27, 1936, pages 318-320. Poorly placed ties on the Smithfield Street Bridge at Pittsburgh concentrated loads on edge of outstanding legs of flanges and subjected them to repeated stresses above the yield point. After 2 years service the condition of the Al-alloy floor system is summarized as follows: 1. The mechanical condition of the Al-members is good with the exception of the stringer flange angles which have been repaired. 2. The field coats of Al paint show deterioration at numerous points on the under side of the bridge, although the priming coat is in good condition. 3. There is no evidence of more than superficial surface corrosion of any Al alloy part. 4. There is no evidence of electrolytic corrosion or corrosion at joints either between Al and Al or Al and steel. CBJ (13)

Erosive Action in Steam Plants. Edward Ingham. *Power & Works Engineer,* Vol. 31, Feb. 1936, pages 62-63. Erosion of boilers and fans by flue dusts, scoring of steam valves and seatings by erosion as well as corrosion, and erosion of turbine blading are discussed. Dust particles should be largely removed from flue gases to prevent fan erosion. Valves and seatings must be finely finished with absolute absence of leaks to avoid erosion. The use of special alloy steels for turbine blades reduces their erosion. FPP (13)

Studies on the Wear of Metals in Gliding Friction (Untersuchungen über das Verschleissverhalten der Metalle bei gleitender Reibung) B. Kehl & E. Siebel. *Archiv für das Eisenhüttenwesen,* Vol. 9, May 1936, pages 563-570. Flat ring samples of steel and cast iron were used, the flat surfaces of 2 rings rubbing against each other as one of the rings revolved. On testing dry the wear increased directly with the load. After surface oxidation started the temperature of the rings rose to above 250° C. Between a speed of 0.2 to 1 m./sec. the wear decreased with increasing speed; beyond this speed the wear increased again. The wear resistance of pearlitic cast Fe increased with the hardness; in C steel a decided decrease in wear only occurred when a martensitic structure was present. When 2 different cast-irons rub against each other the harder one wears more and the softer one less than if both samples were of the same Fe. Harder cast Fe tends to corrode more than soft during wear. Wear and corrosion under oil increased with the roughness of surface. The wear decreased under pure oil as the time of test was prolonged; speed had little effect. Increased loading increased the wear proportionately at first and then as seizing or corrosion occurred the wear increased as much as 100 fold. The results were considered to bear a good correlation with certain service conditions. SE (13)

Corrosion at Permanent and Elastic Deformation (Korrosion bei bleibender und elastischer Verformung) W. O. Kroenig & A. J. Boulitschewa. *Korrosion & Metallschutz,* Vol. 12, Apr. 1936, pages 73-81. Corroding influences exert a different effect depending on whether the material is in a static or dynamic state; a specimen subject to a corrosion test illustrates the former, a part in an engine the latter case. These effects were investigated on Al, duralumin, brass and Fe, and it was found that the electrode potential of the metal or alloy is shifted towards baser values with increasing mechanical stresses, and that the corrosion resistance becomes lower with increasing stress; this resistance was in some solutions 10 times less for stressed than for unstressed specimens. Fe, brass and duralumin have a tendency to intercrystalline corrosion under elastic deformation which is not observed in the unstressed state. 13 references. Ha (13)

Corrosion Resistance of Metals and Alloys. ROBERT J. McKAY & ROBERT WORTHINGTON. Reinhold Publishing Corporation, New York, 1936. Cloth, 6 x 9¼ inches, 492 pages. Price $7.00.

This is No. 71 in the American Chemical Society Monograph series. Corrosion phenomena are notoriously difficult to control and equally difficult to understand, because of the complexity of the variables. This book is a real contribution toward intelligent unscrambling of the variables, toward clear thinking, and hence toward correct understanding and ultimate control. The preliminary chapters on the factors that enter into corrosion and that control corrosion rates, put the reader into the proper frame of mind to accept the authors' warning that the many tables of corrosion rates are to be considered as giving only a general appraisal and not figures from which the life can be calculated down to a day. Really getting that across is no small achievement.

The metals and alloys are taken up in the order: Mg, Al, Zn, Cd, Sn, Pb, Fe, FeSi, Mo, Cr, FeNi, Ni, NiCu, Cu. Under each metal, the corroding materials and environments that the metal resists or fails under, are discussed.

Corrosion-fatigue is dealt with wherever data are available. The question of galvanic attack in contact with other metals is discussed for each metal and alloy. Corrosion in tin cans by various food products is dealt with at quite some length, giving a very good birds-eye view of the problem. Other metal-coated metals are adequately discussed. The authors do not accept the usual view that light, i.e., thin, zinc coatings are to be preferred when galvanized steel must undergo bending.

The discussion of the activity-passivity relations of 18:8 and its congeners and of intergranular attack is both clear and concise.

The behavior of the various alloys in various atmospheres at high temperatures is included as a corrosion phenomenon, though seldom dealt with in as much detail as other types of corrosion. Except for this, little is said about corrosion under non-aqueous conditions, the interesting subject of corrosion of bearing metals not being touched upon.

The authors have spared the reader from having to cope with a complete bibliography, and confine themselves to a selected one, even the chapter on iron and steel requiring but 134 references. The book is well indexed. At the ends of chapters where a blank page or part of a page would normally occur, sketches of a demon "Old Man Corrosion," drawn by the junior author, enliven the pages.

The book is much more than a compilation of existing data on corrosion and corrosion rates for it not only gives the data but continually ties it in together so that the reader is made to consider the processes of corrosion that are going on. Since it covers the most important industrial alloys and handles its subject in such a thoughtful way, it is the best source of information on corrosion in general yet published. H. W. Gillett (13) -B-

Corrosion Resistance of Welds (Korrosionsbeständigkeit von Schweissungen) BÜRGEL. *Autogene Metallbearbeitung,* Vol. 29, May 15, 1936, pages 148-154. The behavior of a metal and of welds of the same or different metals against attack is investigated. Carefully and correctly made gas fusion welds possess, in most cases, at least the same corrosion resistance as the base material, and often a much higher corrosion resistance. Sometimes the transition zone is particularly sensitive, e.g. to HCl, so that this zone is more strongly attacked and more easily destroyed. The reason for this condition is the increase in grain size due to the temperature in this zone. Fine grain shows a greater corrosion resistance than coarse grain. Metal alloys without eutectic are more corrosion resistant than metals with eutectic. Ha (13)

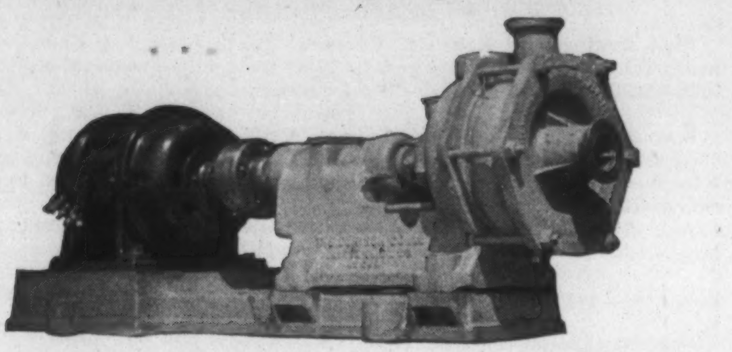
Effect of Sodium Silicate Containing Soda on Differently Pretreated Light Metal (Ueber die Einwirkung von wasserglashaltiger Soda auf verschiedenartig vorbehandeltes Leichtmetall) H. BOHNER. *Aluminium,* Vol. 18, Mar. 1936, pages 102-103. When dipping Al and Al alloys as rolled in a boiling, Na silicate solution containing soda, an instantaneous H evolution takes place in material (1) pickled in HCl up to 2 min., (2) scoured with steel wool, or (3) pickled in NaOH; no further effect is noticed. In material, however, which was sandblasted, or pickled longer than 2 min. in HCl, the H evolution lasts much longer. The stronger the attack of the light metal by HCl, the longer the soda solution with Na silicate must act to produce the protective action. Tests are described in detail. Ha (13)

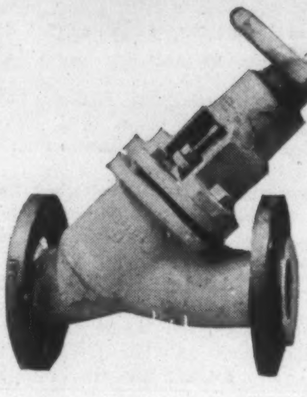
Piston Treatment and Wear. *Gas & Oil Power,* Vol. 30, Dec. 1935, page 296. A note on present status of use of Al pistons in heavy oil engines. FPP (13)

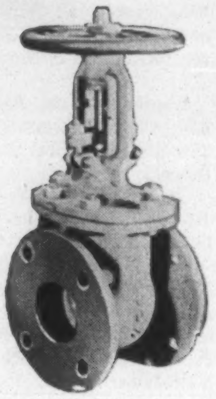
Corrosion and Construction (Korrosion und Konstruktion) KURT ADLOFF. *Die Wärme,* Vol. 59, Jan. 18, 1936, pages 38-42. Discusses corrosion and strength, combatting corrosion by proper design, effect of various anti-corrosion means on the corrosion fatigue of different steels. EF (13)

Corrosion from Products of Combustion of Gas—Part III. The Experiments (continued). 36th Report of the Joint Research Committee of the Institution and Leeds University. JAMES W. WOOD & E. PARRISH. *Institution of Gas Engineers, Communication* No. 121, 1935, 47 pages; *Gas World,* Vol. 103, Nov. 9, 1935, pages 421-422, 431-438; Dec. 7, 1935, pages 540-541; *Gas Journal,* Vol. 212, Nov. 13, 1935, pages 470-472; Dec. 4, 1935, pages 692-693. The products of combustion of gas containing 8.1 grains S/100 ft.^{3} were led through tubes of various composition and the results compared with previous similar experiments with gas containing 25.6 and 51.2 grains S. With the gases of higher-S content, the corrosion products remained in solution; in the present tests there was a tendency for the condensates to throw down precipitates. The rate of corrosion from beginning to end of the tests (as judged by the amount of metal in the condensates) was remarkably uniform for individual materials (with higher S gases there was an initial period of relatively severe attack). When the metals are arranged in order of resistance to corrosion, their sequence is substantially the same for all S concentrations. The metals fall into 3 groups having good, medium and poor resistance to corrosion. Pb, Sn, and solder show a marked superiority to other metals. As the S content of the gas is reduced, the difference between metals of the good and medium groups becomes less pronounced. The metals in the medium group are Al, 70/30 brass, hard Cu and soft Cu. The least resistant metals are Fe, Zn and Ni. The rate of corrosion falls as the S content of the gas is reduced, but the fall is appreciably less than would be expected if corrosion is proportional to S content. The S retained in condensates from the low S gas was 11.4-95.9% that in the gas burned and in every case was a higher proportion of the S originally present than when using gas of higher S content. There was less free acid than before. HNO_3 was never less, sometimes much greater, than in tests with high S. With the resistant materials, the HNO_3 in solution was fairly constant at 0.003-0.005 g./100 cc. AHE (13)

Standard Equipment







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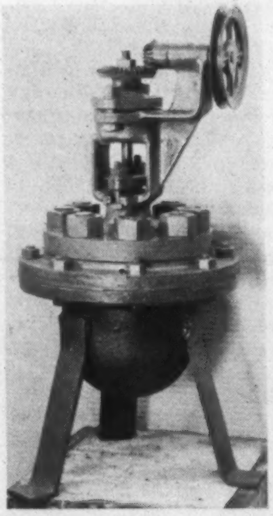

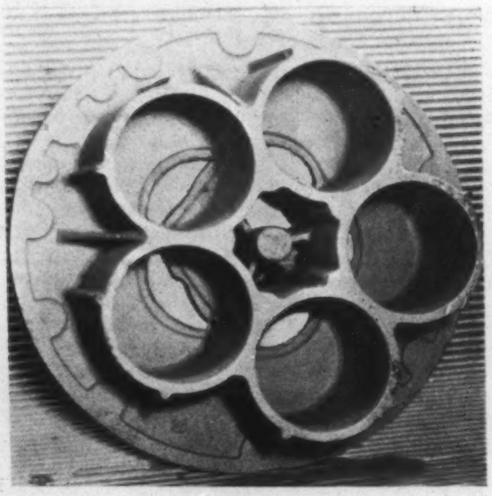

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14. APPLICATION OF METALS AND ALLOYS

Plant Constructional Materials. *Chemical Trade Journal & Chemical Engineer,* Vol. 98, Feb. 28, 1936, page 170. Deals with uses of Ni-clad steel for equipment in the chemical and allied industries. MS (14)

New Articulated Light-Metal Coaches of the Northern Railway of France. Chatel & Yollant. *Railway Gazette,* Vol. 64, Apr. 24, 1936, pages 795-799. 3-coach articulated unit with 7% Mg-Al alloy bodies assembled by welding and attached to a welded steel underframe of braced girder construction is described. The steel used is high tensile material and mechanical design reduces dead weight to a minimum. Lancrenon's special arc welding technique involving rib reinforcement of welds, preheating of parts to be welded and maintenance of horizontal plane at weld during the operation, is employed. FPP (14)

Bimetals (Bimetalle) Geo. Keinath. *Archiv für Technisches Messen,* Vol. 5, Apr. 1936, pages T55-T56. Principles of measurement with a combination of two metals of different thermal properties are explained, forces exerted and compositions used in such combinations are described. Ha (14)

Bibliography of Aeronautics, 1932. Published by the National Advisory Committee for Aeronautics, Washington, D. C., 1936. Cloth, 6¼ x 10¼ inches, 296 pages. Price $.50 from Superintendent of Documents, Government Printing Office.

This issue of the Bibliography covers the aeronautical literature published from Jan. 1 to Dec. 31, 1932. It covers references to the use of metals and alloys in aeronautics. R. Rimbach (14) -B-

Directory of Materials Used in Design of Machines. Reprint from March 1936 *Machine Design,* 36 pages, 9 x 12 inches. Price 25 cents. The 4th edition of the directory is separated into 2 parts: 1. Iron, Steel and Nonferrous Alloys; 2. Plastics and Other Nonmetallic Materials. The various materials are listed by their trade names. Richard Rimbach (14) -B-

■ 14a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Photographs on Electrolytically Oxidized Aluminum (Das Lichtbild auf elektrolytisch oxydiertem Aluminium; Seo-Foto-Verfahren) Alexander Jenny. *Chemiker Zeitung,* Vol. 60, Mar. 25, 1936, pages 257-258. The development of photographic images on oxidized Al has opened an entirely new field of photography. The process consists in impregnating the previously produced "eloxal" film with a solution of an optically sensitive chemical, and subjecting the sensitized film to the customary photochemical treatment. Successful imagine production depends on the thickness, adherence, porosity and hardness of the oxide film. Careful cleaning of the film pores by treatment in hot water or organic solvents is essential. Advantages claimed are the general resistance of such photographs to fire and heat, organic solvents, and abrasion. The cost of such Al oxide photographs is little higher than that of customary reproductions. See also *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 84R/6. FPP (14a)

Aluminium Alloys in Shipbuilding and Marine Engineering. J. W. Donaldson. *Metallurgia,* Vol. 13, May 1936, pages 173-177. Describes applications and alloys used. JLG (14a)

Fifty Years March of Aluminum. F. Reed Dallye. *Electrical World,* Vol. 106, Feb. 15, 1936, pages 24-26. Use of Al as busbar material, for transmission and distribution conductor, and in coil windings is discussed. CBJ (14a)

Aluminum 1936 Practice. F. V. Hartman. *American Machinist,* Vol. 80, Feb. 26, 1936, pages 185-192. The different processes developed for shaping Al, working methods and welding processes are reviewed and modern applications described. Ha (14a)

Development of Aluminum for Aircraft. C. F. Nagel, Jr. *Aero Digest,* Vol. 28, Feb. 1936, pages 27-29, 84. General. WB (14a)

Aluminum is Fifty. Lewis K. Urquhart. *Factory Management & Maintenance,* Vol. 94, Feb. 1936, pages 70-71. New uses of Al discussed include: all-Al train, fire-resistant and fire-retarding partitions on ships, architecture, interior decoration and colored Al. CBJ (14a)

Aluminum Connecting Rods. R. L. Templin. *Mechanical Engineering,* Vol. 58, Mar. 1936, pages 169-170. A forging alloy of 4.4% Cu, 0.8% Si, 0.75% Mn, remainder Al, was used successfully in a large freight locomotive. The stress distribution in the rod was investigated and is diagrammatically explained. Ha (14a)

Properties of Lead-Calcium Alloys for Storage Cell Grids and Plates. Earle E. Schumacher & G. S. Phipps. *Metal Industry,* London, Vol. 47, Nov. 22, 1935, pages 512-513. An abridged form of the original paper. See *Metals & Alloys,* Vol. 7, May 1936, page MA 265L/8. HBG (14a)

Tin and Its Utilisation. *Chemical Trade Journal & Chemical Engineer,* Vol. 95, Aug. 17, 1934, pages 111-112. Summarizes part of "First General Report of International Tin Research and Development Council, 1934." Indicates progress made in researches sponsored by the Council on Sn and its applications. MS (14a)

Aluminum Celebrates Its Fiftieth Anniversary. *Mill & Factory,* Vol. 18, Feb. 1936, pages 53-56 and 116-117. Reviews history and modern uses of Al and its alloys. FPP (14a)

Air Preheaters and Exhaust Pipes of Airplane Motors Made of Inconel (Auspufftöpfe mit Luftvorwärmung aus Inconel für Flugmotoren) *Nickel Berichte,* Vol. 6, Feb. 1936, pages 21-23. The alloy containing 80% Ni, 14% Cr, 6% Fe withstands the temperature of 600°-750° C. of the exhaust gases. The rather complicated construction is assembled by welding. EF (14a)

Aluminum-Copper Alloys. Foundry Practice and Properties. *Metal Industry,* London, Vol. 47, Oct. 11, 1935, pages 368-371; Oct. 18, 1935, pages 391-394. Report of Non-Ferrous Division of A. F. A., in abridged form, which contains practical information for the foundrymen who handle non-ferrous alloys. HBG (14a)

Aluminum Pistons: Details to be Observed to Insure Successful Operation. P. B. Jackson. *Diesel Power,* Vol. 14, Mar. 1936, pages 170-173. To permit high speed operation Al alloys are being employed as Diesel piston materials. Satisfactory performance depends on observance of several fundamental precautions. Piston proportions, i.e. the length and location of wristpin, length of ring belt, amount of space between ring and piston top, piston head design, thickness of metal in the piston head, size of piston rings, dimensions of piston skirt, use of bearings and bosses and composite piston design are discussed as factors affecting the technical and economic advantages of Al alloys as pistons. FPP (14a)

Aluminium in Rolling Stock Construction. Ernest V. Pannell. *Railway Gazette,* Vol. 64, Mar. 27, 1936, pages 613-614. The important effects of train weight on energy or fuel consumption and on permanent way maintenance are discussed. Weight reduction must not sacrifice strength, and Al alloys offer cumulative advantage in this respect. Additional advantage of Al alloys is their very low modulus of elasticity which reduces the disastrous effect of possible railroad collisions. A review of present application of Al to train construction in America and Great Britain is included. FPP (14a)

Non-Ferrous Metals. *Times [London] Trade & Engineering,* Vol. 38, Jan. 1936, page XVII. Reviews developments during 1935 in industrial applications of alloys, metal protection processes, and research. MS (14a)

Cost Savings Afforded by Alloy Anchorage of Punches and Dies. *Steel,* Vol. 98, Mar. 30, 1936, pages 35-36. Cost of complicated assembly of punches and dies can be reduced substantially by machining the punches and dies in separate sections, mounting them in a shoe or die-block, and cementing them in place with Cerromatrix. Punch assemblies are located by fitting them into punch plate. They are then fastened to an auxiliary holding plate by means of screws. Regular punch holder is clamped to auxiliary plate and entire assembly is withdrawn from punch plate. Assembly is inverted, preheated from below to prevent drawing temper of hardened parts, and alloy is poured. Cerromatrix is composed of Bi, Pb, Sn, and Sb; has a tensile strength of 13,000 lbs./in.^{2}, Brinell hardness of 19, and elongation of less than 1%; and is sufficiently hard to hold punch and die parts permanently in their proper locations. Its m.p. is 248° F., pouring range, 300°-350° F., and freezing range, 260°-216° F. It should be allowed to stand for 12 hrs. after pouring as it age hardens. It expands approximately 0.002"/in. on cooling. It in no way "wets" the steel, and therefore, it is necessary to provide a mechanical anchorage from alloy to piece to be held and from alloy to holding medium. Die-blocks and punches must rest firmly against a solid steel or Fe foundation and no alloy must be allowed to flow beneath either die-block or punch. Other uses of alloy are material for molds for pressing cold-formed plastics, short-run forming dies for light-gage sheet-metal, stripper plates, etc. MS (14a)

■ 14b. Ferrous ■

M. GENSAMER, SECTION EDITOR

Sectional Steel Poles. *Electrician,* Vol. 116, Apr. 24, 1936, pages 552-553. Light-weight sectional steel poles for supporting overhead lines or lamp standards used in Europe are described. CBJ (14b)

Scrap-Rail Flooring Mats Withstand Severe Abuse. *Railway Engineering & Maintenance,* Vol. 32, Apr. 1936, page 243. The Erie Railroad has effectively used scrap rails as flooring at local spots in locomotive shops subject to unusually severe wear or abuse. Lengths of rails, laid base up and parallel to form a mat, are grouted into the floor. The grout filler prevents possible breakage of the base flanges. Sections of such rail mat floorings are still in service after more than a year. FPP (14b)

Cold Heading Dies and Die Steels. J. C. Alexander. *Heat Treating & Forging,* Vol. 22, Apr. 1936, pages 171-173. See *Metals & Alloys,* Vol. 7, May 1936, page MA 265R/10. MS (14b)

Prolonging the Life of Rails. C. B. Bronson. *Railway Engineering & Maintenance,* Vol. 32, May 1936, pages 302-305. From a paper presented before International Railway Maintenance Club. Rail renewals are required because of direct rail failures (crushed heads, fissure and base breaks, web cracks etc.), joint conditions, head wear, rails damaged by faulty equipment, and corrosion. Corrosion and joint problems are most serious. Poor joints may often be salvaged by welding repair, but defects should be removed from joint bars. Reference is made to importance of rail manufacturing methods and to H. F. Moore's investigation of transverse fissures and cooling conditions. FPP (14b)

Coal Cutter Picks. A. J. Beeley. *Edgar Allen-Buell Gazette,* Vol. 2, Mar.-Apr. 1936, pages 131-134. The best material for coal cutting tools is a rather dense steel of fine grain; the temperatures in heat treatment should be carefully observed as otherwise coarse crystals and brittleness might occur. Prescription for the treatment of a special steel (composition not given) is given in detail. Ha (14b)

Steels for Dies for Plastic Materials. *Edgar Allen News,* Vol. 14, Apr. 1936, pages 824-825. The various steels manufactured by the Edgar Allen Co. and their heat treatment and mechanical working are described briefly. Ha (14b)

Standard Specifications for Lock-Bar Steel Pipe. *American Society for Testing Materials,* A. S. T. M. Designation: A 137-34; *American Standards Association,* A. S. A. No.: B 36.7-1935, 5 pages. AHE (14b)

Nickel Steel Saves Weight, Prolongs Life of Boilers and Fireboxes. R. E. PENROD. *Steel,* Vol. 98, Mar. 23, 1936, pages 53, 55. Lehigh Valley Railroad has put 27 new locomotives in service since 1931, in which Ni-steel plate is used for boiler and fire-box elements. They were fabricated by 2 different builders, each using a different composition of steel. These locomotives have been in almost continuous service without need for repairs to either boiler or fire-boxes. Minimum tensile strength of boiler steel was specified as 75,000 lbs./in.^{2} and of fire-box steel as 65,000 lbs./in.^{2} making possible a saving of 9000 lbs. in overall weight of each unit. MS (14b)

Locked Coil Winding Ropes. RICHARD SAXTON. *Metallurgia,* Vol. 13, Feb. 1936, pages 117-118. Describes different designs of locked-coil rope and discusses problems arising in their manufacture. JLG (14b)

Foreign Raw Materials for Special Steels for Chemical Equipment (Beitrag zur Frage der ausländischen Rohstoffe in Sonderstählen des chemischen Apparatebaus) P. SCHAFMEISTER. *Technische Mitteilungen Krupp,* Vol. 3, Nov. 1935, pages 218-223. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 153L/5. Ha (14b)

Nickel Alloy Constructional Steels. D. A. NEMSER. *Modern Machine Shop,* Vol. 8, Mar. 1936, pages 40-48. The various uses of Ni alloy steels in the tool and die fields are discussed, their classification according to SAE specifications explained, their composition and heat treatment described, and tables of mechanical properties given. Ha (14b)

Progress in the Production of Cast Iron for Locomotive Parts. A. REYBURN. *Transactions American Foundrymen's Association,* Vol. 6, Dec. 1935, pages 151-160. Following the World War, Canadian railroads were rehabilitated and larger and heavier motive power was introduced. Failures of locomotive cylinders in this heavier equipment focused attention on cast Fe. The new developments resulted in a new specification requiring a cast Fe with an analysis as follows: Si 0.80-1.10% (0.90 desired), S 0.11% maximum, Mn 0.80-1.00% (1.00 desired), P 0.20% maximum, total C 3.00-3.20%, Ni 0.75% minimum, and a Brinell hardness of 240 and a deflection of 0.13″ on 1¼″ diameter bar, 12″ centers, load 4,000 lbs. The types of irons used for such parts as cylinder liners, valve bushings, pistons, bullrings, and packing-rings together with the general molding and core-making practice for cylinders are outlined. The use of Ni and Ni-Cr cast irons has in several instances increased life of parts and saved considerable cost to the railroads. CEJ (14b)

Yoloy—Its Properties and Welding. FRED J. ESSLINGER. *Welding Journal,* N. Y., Vol. 15, Jan. 1936, pages 18-19. Discussion of a new Youngstown Sheet and Tube Co. product, a high tensile, low alloy steel whose superior properties are due to the alloying elements, P, Cu and Ni. Compared with mild steel it has yield point almost doubled, very high tensile strength and fair ductility. Atmospheric and soil corrosion resistance is stated to be superior together with excellent fatigue and impact resistance. An important feature of the material is that its strength is increased by heating to 1000-1200° F. and cooling, and because of this it is considered to be especially suitable for welding pressure vessels, etc. No difficulties met with in welding with fluxed wire in the low C contents, but higher C contents require preheating and bottom layer of mild steel which may or may not be chipped out as conditions require. Stress relief of welded sections considered almost indispensable, procedure being 1½ hrs. at 1200° F. for each 1″ of thickness. Tables of mechanical properties are presented. WB (14b)

Forty-Five Tons of Steel Used in Building this House. *Steel,* Vol. 97, Dec. 9, 1935, pages 17-18. Describes house under construction near Toledo, O., which employs welded steel frame. Floors and walls use about 43½ tons of steel, while about 1½ tons are in loose lintels. MS (14b)

Resilient Post Bracket Supports Free Cables in New Highway Guard. *Steel,* Vol. 97, Dec. 9, 1935, page 50. Development of American Steel & Wire Co. Cables are held taut by 2 end anchor posts, but are free to move horizontally through intermediate post brackets. Bracket is shaped to provide flexibility under direct impact from moving vehicle. Recommended composition of steel for brackets is 0.60-0.75% C, 0.40-0.70% Mn, 0.05% maximum S, and 0.04% maximum P. Hardness after tempering should be 40-45 Rockwell C. Cables and fittings are galvanized. MS (14b)

Stresses in the Steel Reinforcement of Reinforced Concrete Structures. R. H. EVANS. *Structural Engineer,* Vol. 63, Sept. 1935, pages 354-369. Paper before the Yorkshire Branch of the Institution of Structural Engineers at Leeds, Mar. 1935, contains 11 diagrams and bibliography. WH (14b)

Steel Alloys. WALTER M. MITCHELL. *Food Industries,* Vol. 7, Dec. 1935, pages 577-579. Strength, non-corrosive properties, light weight in fabricated forms and a permanent bright, clean appearance are properties of stainless steel of the 18-8 type of particular importance in handling foods. There is no deleterious action of 18-8 on foods. Stainless alloys are much used in equipment for handling fruit juices, in wineries and breweries and in the dairy industry. The use of "stabilized" 18-8 is advocated for beer tanks and vats fabricated by welding and in other applications where corrosive conditions are met. Such stabilization against danger of locally increased susceptibility to chemical attack is accomplished by the addition of Ti or Cb followed by a suitable heat treatment. BWG (14b)

Making Forgings for Otis Elevators. J. B. NEALEY. *Heat Treating & Forging,* Vol. 21, Nov. 1935, pages 522-523. Describes steel foundry and machine-shop of Otis Elevator Co. at Buffalo, N. Y. Foundry has a 1000-lb. and 2 6-ton electric melting-furnaces and 3 gas-fired car-bottom type ovens for drying molds. Forge department has 7 gas-fired furnaces. MS (14b)

15. GENERAL . .

RICHARD RIMBACH, SECTION EDITOR

* * *

Key Words to the Metallurgy of Steel. Second Edition. G. A. DEBELIN & E. E. G. BRADBURY. Greenup & Thompson, Ltd., Sheffield, England, 1935. Paper, 4 x 6 inches, 46 pages. Price 9d.

This little book contains key words to the metallurgy of steel, and is intended primarily for practical men. In the preface it states: "While the authors believe that the definitions are not scientifically inaccurate, their object has been to achieve lucidity from the point of view of the ordinary individual, although this may occasionally have involved some looseness of phrasing." In spite of this the booklet should be very useful. R. Rimbach (15) -B-

VDI Jahrbuch 1936. Die Chronik der Technik. VDI Verlag GMBH, Berlin 1936. Paper, 5¾ x 8¼ inches, 192 pages. Price 3.50 RM.

The third volume of the VDI-Jahrbuch, which gives an annual bird's eye view of the developments made in all branches of science, has been prepared by 85 specialists under the direction of G. Garbtotz, Director of the Verein deutscher Ingenieure. Six thousand references are mentioned and 2300 subject listings are included.

The second volume of the Jahrbuch appeared in 1936 and contained 183 pages (Price 3.50 RM); 5000 literature references. The review of Vol. 1 of the Jahrbuch appeared in *Metals & Alloys,* Vol. 5, June 1934, page MA 300. R. Rimbach (15) -B-

Invention and the Law. H. A. TOULMIN, Jr., Prentice-Hall, Inc., New York, 1936. Cloth, 6 x 9 inches, 399 pages. Price $5.08.

This discussion of what is and is not patentable is primarily aimed to help the patent lawyer by collecting court findings that bring out the various points. Much of the text consists of excerpts from court decisions and there is a copious bibliography. These are chosen to express general principles without going into detail as to the exact features of the case in question. This gives the reader little aid in grasping the abstract principles through the means of an easily visualized specific example, but it keeps out the danger of having the reader's mind wander from the main track.

The book stresses that an invention may be a real and patentable invention even though it may be extremely simple, and that it is the last step that counts. The comments on transference from one art to another are helpful. One wishes that the doctrine of equivalents in compositions of matter had been more fully dealt with.

English patent practice is discussed because of its analogy to American practice, that of other countries is not covered in detail.

Most such books are of doubtful value to those up against patent matters but not versed in patent law. This is distinctly more intelligible to the general reader than the common run. H.W. Gillett (15) -B-

Advertising and Selling Industrial Goods. VERGIL D. REED. Ronald Press Company, New York, 1936. Cloth, 5¾ x 8½ inches, 287 pages. Price $3.50.

Mr. Reed, who is Associate Professor of Marketing and Foreign Trade, Boston University, is also Chief, Retail and Wholesale Trade, Bureau of the Census, U. S. Department of Commerce.

The volume deals with the strategy, tactics and technique involved in advertising and sales promotion of industrial goods. It prevents practical suggestions to advertising and sales executives as a guide in the development of sound plans. The subject is presented in a manner to be helpful to small and medium sized companies, which are dependent upon the most effective use of limited appropriations to attain their marketing objectives.. R. Rimbach (15) -B-

Research Laboratory of the London, Midland and Southern Railway. *Metal Industry,* London, Vol. 47, Dec. 13, 1935, pages 591-593. A description of the opening of the new research laboratory of this company by Lord Rutherford of Nelson. The history of the beginning and growth of railway laboratories is related and the development of the research policy is outlined. The functions of the different sections are indicated and the different rooms and their equipment are described. HBG (15)

Production, Heat Treatment, and Properties of Iron Alloys. LOUIS JORDAN. *National Bureau of Standards Circular,* C 409, Mar. 17, 1936, 40 pages. Prepared in response to many requests for a brief and simplified statement of the principles of the heat treatment of steels and for a similarly simplified statement covering the production and properties of Fe alloys in general. This circular gives particular consideration to recently developed theories of the hardening of steel and the role of special alloying elements in steel. It describes very briefly the reduction of Fe ore, the production and properties of cast Fe, production and fabrication of steel, and also discusses the fundamental principles upon which the heat treatment of steel is based. There are also included brief discussions of the equipment used in heat treating processes and the major types and chief characteristic properties of alloy steels. LJW (15)

What do Recent Developments in Non-Ferrous Metallurgy Bring to the Ferrous Metallurgist? (Was bringt dem Eisenhüttenmann die neuere Entwicklung in der Technik der Nichteisenmetalle?) G. MASING. *Stahl und Eisen,* Vol. 56, Apr. 16, 1936, pages 457-465. Recent developments in non-ferrous metallurgy are discussed and their bearing on or similarity to ferrous metallurgical problems brought out. SE (15)

Review of Iron and Steel Literature for 1935. E. H. MCCLELLAND. *Blast Furnace & Steel Plant,* Vol. 24, Jan. 1936, pages 59-64; *Heat Treating & Forging,* Vol. 22, Jan. 1936, pages 25-30. 19th annual classified list of the more important separately published books and pamphlets of the year, with a few of 1934 not available for inclusion in last year's list. Will be reprinted, with additions, by the Carnegie Library of Pittsburgh and may be obtained gratis. MS (15)

The Role of Patents in Modern Metallurgy. ANTHONY WILLIAM DELLER. *Metals & Alloys,* Vol. 6, Nov. 1935, pages 313-316. 22 references. Discussion of the use and value of patents in protecting inventions. Several metallurgical patents and cases growing out of them are discussed. WLC (15)

■ 15a. Economic ■

Metal Statistics—1936. Twenty-ninth Annual Edition. American Metal Market, New York. Cloth, 4 x 6⅛ inches, 572 pages. Price $2.00.

Statistics are given on: Iron and Steel; Fuels; Aluminium: Canadian exports; imports; N. Y. prices; U. S. production; scrap prices; U. S. secondary production; world production; Antimony: U. S. consumption; prices 1898-1910; imports; U. S. production; N. Y. prices; world production; Copper: brands; prices; U. S. and world consumption; exports; grades and descriptions; imports; prices; production; refinery capacities of U. S. A. and Canada; sales agencies of principal producers; scrap prices; U. S. secondary production; sellers; shipments; stocks; uses; world consumption and production; Copper, Brass, and Bronze Products: deliveries; price changes; exports; imports; Lead: analyses; prices; brands; U. S. and world consumption; exports; grades; imports; producers U. S. and world production; shipments; stocks; Nickel: Canadian production and exports; forms of nickel and Monel metal; production of by-product nickel; imports; exports; prices; Platinum metals: imports and exports; consumption; prices; U. S. and world production; stocks; Silver: brands; U. S. consumption and imports; U. S. and world production; prices; Tin: analyses; Bolivian tin ore arrivals; consumption; deliveries; imports; prices; production; scrap prices; stocks; supplies, &c.; Zinc: analyses; brands; concentrate prices; consumption; exports; imports; grades; prices; producers; U. S. and world's production; sheet prices; scrap prices; U. S. secondary production; stocks; world consumption; retorts in operation, by years; Gold: prices; production; U. S. imports and exports; Magnesium: U. S. prices, imports and consumption; Quicksilver: production; N. Y. prices; imports, exports. R. Rimbach (15a) -B-

British Iron and Steel Industry in 1935. EARL OF DUDLEY. *Iron & Coal Trades Review,* Vol. 132, Jan. 17, 1936, pages 111-112. Review and statistics. Ha (15a)

Bavarian Non-Ferrous Mining and Its Future Possibilities (Aufschlussarbeiten im bayerischen Erzbergbau auf Nichteisenmetalle und ihre weiteren Entwicklungsmöglichkeiten) F. BUSCHENDORF. *Metall und Erz,* Vol. 33, Jan. 1936, pages 11-18. The occurrence of ore in Bavaria is summarized and tabulated according to metal content, geographical location, and type of deposit. Important deposits discussed are those of pyrites, Hg, Sn, Au and Pb ores. FPP (15a)

Metallurgical Problems and Possibilities for Adjusting the Supply of Raw Materials (Metallurgische Aufgaben und Möglichkeiten zur Anpassung an die Rohstofflage) H. BANSEN. *Stahl und Eisen,* Vol. 56, Jan. 2, 1936, pages 1-10. Flow sheets for Fe, Mn, and P consumption show the dependence of Germany on imports. Ways are indicated for making Germany self sufficient. SE (15a)

Trends in American Alloy Steel Production. EDWIN F. CONE. *Metals & Alloys,* Vol. 7, June 1936, pages 162-163. Statistical. Shows increasing trend in use of alloy steel for ingot and casting production. WLC (15a)

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Manganese Ore Deposits of the World and Their Significance for the German Steel Industry (Die Manganerz-Lagerstätten der Welt und ihre Bedeutung für die deutsche Industrie) F. HERMANN. *Stahl und Eisen,* Vol. 56, Mar. 26, 1936, pages 381-386. The development of German Mn ore imports and their displacement after the war are discussed. The important exporting countries are Russia, British India, Brazil, and recently Africa, where very large deposits have been located. SE (15a)

The Technical Man's Part in Sales Promotion. LAWRENCE S. HAMAKER. *Metal Progress,* Vol. 29, Mar. 1936, pages 36-40. Discusses new methods of marketing in the steel industry and the use of technical men in such development. WLC (15a)

Measuring Technique for Steel Plants (Messtechnik für Hüttenwerke) S. HINRICHS. *Archiv für Technisches Messen,* Vol. 5, Apr. 1936, pages T47-T48. The profits accruing from correct and careful measurements of the processes and operation in all parts of a steel plant are explained and a bibliographical list of 92 articles is given referring to all measurements which should be considered. Ha (15a)

Economics of the Iron and Steel Industry in the British Empire (Die Eisenwirtschaft im englischen Weltreich) J. W. REICHERT. *Stahl und Eisen,* Vol. 56, Mar. 5, 1936, pages 297-305. Summary of Fe and steel production in the British Empire and of imports and exports between 1924-1935. SE (15a)

Junk to You. PHILIP H. SMITH. *Scientific American,* Vol. 154, Apr. 1936, pages 186-188. Discussion of the billion dollar scrap metals industry. CBJ (15a)

Post-war Development of the Swedish Iron and Steel Industry. K. WISTRAND. *Iron & Coal Trades Review,* Vol. 132, May 1, 1936, page 805. Ha (15a)

The Soviet Non-Ferrous Metal Industries—Some Recent Developments Reviewed. *Metal Industry,* London, Vol. 47, Dec. 6, 1935, page 563. Due to the introduction of modern methods, the non-ferrous metal industry of the Soviet Union has proved this to be one of the richest countries in these metals. It is expected that by the beginning of the Third Five-Year Plan, the Soviet Union should occupy first place in production in Europe and an important place in world economics. Due to the location of the deposits there are a number of difficulties to be overcome such as an adequate supply of fresh water, available labor and necessary training of personnel. The technique in all of these industries is being brought up-to-date and experiments on the utilization of raw materials and waste products have been successful. HBG (15a)

Metallurgy in Belgium and the Belgian Congo (La Métallurgie en Belgique et au Congo Belge). E. PROST. Dunod, Paris, 1936. Paper, 4¾ x 7½ inches, 340 pages. Price 35 Fr.

Historical, tracing developments since 1345, also descriptive of the present situation, listing the firms in operation and giving many world production statistics. The description of the devastation of the Belgian steel works by the Germans during the war carries such adjectives as abominable, bestial and barbarous, indicating that German behavior has not been forgiven. Emphasis is laid on the importance of electric melting of steel and of electric melting and duplexing of cast Fe in present day Belgian practice.

Considerable attention is paid to the various past and present Zn furnaces. The N. J. Zinc vertical retort is rated as well worth the attention of the Belgian producers. Competition of electrolytic Zn, with its purer product is noted. Because of Belgium's water power, it is considered fitting that electrolytic should advance there, and Vielle-Montague is installing equipment to produce 500 tons per month at one plant, and has an electrolytic operation going at another plant that produced 22,000 tons in 1934. The Cd production is being stepped up, the rising price having brought back into production a Belgian plant whose Cd department was closed from 1931 to 1935.

Attention is then paid to Belgian refining of Pb, Ag, Cu, Ni and Sb. The scene then shifts to the Belgian Congo, with discussion of Cu, Co, Au, Sn and Ra, on which the technical discussion is very brief.

The book is of considerable interest from the economic point of view. On the technical side, the information is rather scanty, though Zn is treated more fully than the other metals. H. W. Gillett (15a) -B-

Metallurgy, Mechanical and Electrical Construction (Métallurgie, Construction Mecanique et Electrique). D. HALLET, Brussels, 1935. Paper, 5 x 8¾ inches, 224 pages. Price 50 Belgian Fr.

This publication classifies geographically and by products the metallurgical and engineering companies in Belgium and Luxembourg. Lists of professional, trade and sales associations, as well as an index of supplies to the metallurgical industries are included. R. Rimbach (15a) -B-

■ 15b. Historical ■

Excavations in Prehistoric Iron Works of Westphalia (Die Grabungen auf vorgeschichtlichen Eisenhüttenplätzen des Siegerlandes, ihre Bedeutung und die hüttentechnischen Erfahrungen im Vergleich mit anderen Funden) J. W. GILLES. *Stahl und Eisen,* Vol. 56, Feb. 27, 1936, pages 252-263. Busy Fe works existed in this region from 500 B.C. on. Using the Mn containing Westphalian Fe ores and charcoal, Fe, higher carbon Fe, and even cast Fe were made. Mechanical properties and chemical analyses of some of the samples discovered are given. Much of the product must have been used in trading with regions to the south and west. Further excavation is needed. 138 references. SE (15b)

Ethiopian Blast Furnace. W. J. MCCAUGHEY. *Metal Progress,* Vol. 29, Jan. 1936, pages 62-63. Describes construction and operation of primitive blast furnaces in Central Africa. WLC (15b)

History of Aluminium. Fifty Years of Aluminum Electrolysis (Aus der Geschichte des Aluminiums. Fünfzig Jahre Aluminiumelektrolyse) A. v. ZEERLEDER. *Aluminium,* Vol. 18, Apr. 1936, pages 163-172. Photographs of persons and illustrations of equipment concerned in the development are given. Ha (15b)

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An Outline of Steel and Iron. ARCHIBALD ALLISON. H. F. & G. Witherby, Ltd., London, 1936. Cloth, 5¼ x 8 inches, 191 pages. Price 6s.

This book is a very interesting outline which will be read with value by the layman and the student of metallurgy. It is obvious that the treatment must be brief, but the author has prepared a bibiliography of books for reference. Unfortunately he has omitted the names of the publishers which does not make the list of much value outside the large reference libraries. This list is also limited to books in the English language, and even here no mention is made of: Spring—Non-Technical Chats on Iron and Steel, 2nd Edition, 1927, Frederick A. Stokes Co., New York; Walker—The Story of Steel, 1926, Harper & Bros., New York; and Wilhelm—The Book of Metals, 1932, Harper & Bros., New York.

The book has many interesting historical references and illustrations.

Richard Rimbach (15b) -B-

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Fifty Years of Aluminum Alloy Development. E. H. DIX, JR. & J. J. BOWMAN. *Metals & Alloys,* Vol. 7, Feb. 1936, pages 29-34. Historical.
WLC (15b)

Contributions of Aluminum to Metallurgical Progress. JUNIUS D. EDWARDS. *Metal Progress,* Vol. 29, Feb. 1936, pages 34-39. Historical. WLC (15b)

Notes in the History of Metallurgy—Russell W. Davenport. H. W. GILLETT. *Metals & Alloys,* Vol. 7, June 1936, pages 153-154. Recounts work of Davenport in development of heavy forging industry in this country. WLC (15b)

Incidents in the History of Aluminium. *Aluminium & Non-Ferrous Review,* Vol. 1, Jan. 1936, pages 142-145. Historical, with particular reference to the use of the metal in cooking utensils. JCC (15b)

CURRENT NEWS ITEMS

A Correction—Nickel Steels at Low Temperatures

To the Editor: In the July issue of your valuable magazine I believe that I have located an unfortunate error in the article on nickel steels at low temperatures, by Aldridge and Shepherd. In Fig. 16, on page 192, it would appear that the draftsman who drew this chart has interchanged the numbers 4 and 6 in marking the curves for reference to the table at the top of the chart. As reproduced in Metals and Alloys, the figure indicates that the unalloyed carbon steel plate showed very good resistance to impact at low temperatures and that the nickel steel casting was very poor in this respect, whereas the contrary is actually the case.

Since it is quite possible that many readers may glance at this chart without carefully reading the text, it would appear to the writer that it would be well to point this error out in a future edition in order to avoid any misunderstanding.

J. W. Sands,
Res. and Dev. Division

International Nickel Co., Inc.
New York

A Beryllium Non-Ferrous Foundry

The Beryllium Corp. of Pennsylvania, Reading, Pa., announces the opening of a non-ferrous foundry department specializing in the production of heat-treated castings of beryllium alloys. Present facilities will take care of both large and small castings for electrical parts, machine parts and dies of beryllium copper, and other special alloys. Special foundry technique has been developed to make possible the best combinations of properties for these heat-treatable non-ferrous alloys.

Alloy Steels Simplified

A new publication, entitled "Alloy Steels Simplified," has been issued by the Carpenter Steel Co., Reading, Pa. Recognizing that the market for automotive alloy steels divides itself into two classes: The large tonnage buyers and the small tonnage buyers, the company has felt that buyers in the second class have been much confused by the multiplicity of structural alloys recently developed.

The purpose of this attractive and excellently conceived pamphlet is to simplify the alloy steels as far as possible and still cover the complete requirements of the small buyer. The publication is a valuable help and can be obtained free of charge to users of alloy steels in the United States.

Electrochemical Society's October Meeting

The Electrochemical Society will hold its 70th convention at the General Brock Hotel, overlooking Niagara Falls, Canada, Oct. 8 to 10. The general subject of the convention will be electrochemical products produced through the use of high temperature electric furnaces. "Power for Electric Furnaces" will be a feature symposium. A second session will be devoted to "What the Electric Furnace Has Done for Civilization," organized under the direction of F. J. Vosburgh of the National Carbon Co., New York.

Exhibit of Metals and Minerals

The American Institute of Mining and Metallurgical Engineers, in cooperation with the Metal Products Exhibits, Inc., has assembled an interesting and instructive exhibition which reveals the metallic elements present in the earth's crust, their availability, the locations of commercial sources and the flow of metals and minerals in world trade. Genuine ores, metals, and typical fabricated metal products, including specimens and displays supplied by State and Federal agencies as well as the major metal producing companies, are being shown.

This special exposition is open from Aug. 17 to Oct. 17 at the Metal Products Exhibits in the International Building at Rockefeller Center. It is open every weekday from 10 a.m. to 6 p.m. except Saturday, when the closing hour is 3 p.m. Admission is free.

"Clinics" on Welding Practice for Non-Ferrous Alloys

Latest developments in welding practice for non-ferrous alloys will be demonstrated at two "clinics" to be held in Cleveland and Buffalo, N. Y., during September. Included will be practical examples and demonstrations of the latest methods of electric and oxy-acetylene welding and brazing on Monel, aluminum, nickel, copper, brass, bronze, Inconel, and nickel-clad steel.

The "clinic" at Cleveland will be conducted by welding engineers of the International Nickel Co., the Aluminum Co. of America, and the Revere Copper & Brass Co. It will be held in the warehouse of Williams & Co., Inc., 1748-56 East 22nd St., on Sept. 18 and 19.

At Buffalo, the clinic will be held on Sept. 25 and 26 in the warehouse of Whitehead Metal Products Co. of New York, Inc., 254 Court St. It will be under the auspices of the International Nickel Co., the Aluminum Co. of America, and the American Brass Co. Somewhat similar clinics have been planned for Montreal and Toronto in October.

Technical Features of the Metal Show

Fifty-seven lectures and papers, dealing with every important phase of metallurgical engineering, will be presented during the technical sessions of the eighteenth annual convention of the American Society for Metals, to be held in Cleveland, Oct. 19 through 23, as a part of the National Metal Show. This announcement has been made by Robert S. Archer, president of the society and chief metallurgist in the Chicago district for Republic Steel Corp.

"This program gives the society the largest and most comprehensive list of talks ever scheduled, exceeding even last year's technical sessions. Papers will be presented each morning and afternoon of the convention, with the exception of Wednesday morning, when the society's annual meeting will be held and the 1936 Edward De Mille Campbell Memorial Lecture presented by J. P. Gill, chief metallurgist of the Vanadium Alloys Steel Co.

"The large number of papers to be presented at the 1936 convention again makes necessary the staging of simultaneous sessions," Mr. Archer continued. However, these have been arranged so that there will be no conflict with regard to subjects. In other words, no papers on the same subject will be presented at the same time and members will be able to hear all important lectures relating to their particular branch of the metal industry. There will be simultaneous sessions Tuesday, Thursday and Friday mornings and Thursday and Friday afternoons.

"Other features of this year's technical program are the lectures on 'Physical Testing of Metals' by Prof. H. D. Churchill, professor of mechanics at Case School of Applied Science, and the three lectures on X-Ray by Dr. Kent R. VanHorn, metallurgist of the Aluminum Co. of America."

Research Associates at Battelle

Clyde E. Williams, director, Battelle Memorial Institute, has announced the appointment of four research associates at Battelle for 1936-1937. The research associate plan, which is designed to supplement the work of the institute in fundamental research, is new this year. It is expected that a number of additional associates will be available in the future. Alfred Clark, Ph.D., University of Illinois, 1935, has been assigned a research project dealing with fundamental problems in chemistry; John E. Dorn, Ph.D., University of Minnesota, 1936, in metallurgy; Robert P. Graham, M.S., University of Washington, 1936, in ceramics; and L. G. Turnbull, Ph.D., University of Toronto, 1936, in industrial physics.

Elmer A. Schneider, formerly owner of the Mishawaka Pyrometer Instrument Co., is now production manager for **Wheelco Instruments Co.,** 1112 Milwaukee Ave., Chicago. Mr. Schneider was formerly with Leeds & Northup, and later with the Brown Instrument Co. and the pyrometric division of the Republic Flow Meter Co. **George W. Keller,** formerly vice-president of the Brown Instrument Co., is now in charge of the Eastern Sales Division of the Wheelco company.

MANUFACTURERS' LITERATURE

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (936)

Air Operated Control Instruments

A colorful pamphlet devoted to the Air-O-Line controllers contains the statement that engineers like it because it insures maximum accuracy; it is easily adapted to any process control requirement as the throttling range and automatic reset dials are easily accessible and can be reached without removing the chart plate and taking the instrument off control; the balanced bellows system insures exact control point setting; and it is rugged. Illustrated. Brown Instrument Co., Philadelphia, Pa. (937)

Hi-Steel

Information concerning chemical composition, physical properties and corrosion resistance of this steel is offered by the Inland Steel Company, Chicago, Ill. (938)

Truck Body Construction

Through the use of the light, strong alloys of Alcoa Aluminum, bodies have been built which weigh only 35 to 60 per cent as much as they would have if built of heavier structural materials, according to this catalog. A table of recommended alloys for different applications is included. The alloys are available in the form of structural shapes, sheet plate, rivets, bolts, nuts, castings and forgings. Aluminum Co. of America, Pittsburgh, Pa. (939)

Insulation

Some looseleaf pages devoted to Therm-O-flake granules, a mineral insulator; Therm-O-flake coating, a high temperature insulation, Therm-O-flake light weight insulating brick and Therm-O-flake light weight concrete or castable insulation have been issued by the Illinois Clay Products Co., Joliet, Ill. (940)

Gas Fired Furnace

The manufacturer of the gas fired Lindberg Cyclone furnace for heating at temperatures from 250 deg. F. to 1400 deg. F. claims that the heating rate is remarkably fast, and either open or extremely dense charges are handled with equal facility. The principle of the furnace is described in Bulletin 51. Illustrations. Lindberg Engineering Co., Chicago, Ill. (941)

Flame-Otrol

This automatic gas shut off which is simple, positive in operation and operates with split second speed, according to the manufacturers, is the subject of an illustrated pamphlet. Wheelco Instruments Co., Chicago, Ill. (942)

Wheelabrator Tum-Blast Cleaner

This cleaner, which it is claimed sets the highest standard of efficiency ever attained in an abrasive cleaning machine is a combination of the Tum-Blast Cleaner and the Wheelabrator. Book 111 is devoted to it. American Foundry Equipment Co., Mishawaka, Ind. (943)

Controlled Atmosphere Electric Furnaces

This booklet lists advantages to be derived by the use of these furnaces and contains many illustrations of typical installations for annealing or normalizing without oxidation, for hardening without scale and for electric-furnace brazing. General Electric Co., Schenectady, N. Y. (944)

Konik

Data on this steel's physical properties, corrosion resistance and working are offered by the Continental Steel Corp., Kokomo, Ind. (945)

Sonittep Products

This booklet discusses heat loss and its control. The advantage of Sonittep insulating cement and its uses are listed. Instructions for its application are included. Graphs. George F. Pettinos, Inc., Philadelphia, Pa. (946)

Sixteen Sins of the Cleaning Room

Are listed in a circular for convenience in checking on cleaning rooms. Great Lakes Foundry Sand Co., Detroit, Mich. (947)

Armco H.T.-50

An illustrated folder devoted to the above alloy steel contains data on the average physical properties, corrosion resistance and forming and welding qualities. American Rolling Mill Co., Middletown, O. (948)

Heavy Duty Refractories

This handbook contains complete descriptions, applications, tables and illustrations of standard shapes. Many useful engineering data are included. Norton Company, Worcester, Mass. (949)

Braze-Rite Furnace

This furnace, developed principally for brazing sintered carbide cutting tools, provides for localized heat to be applied only to the portion of the tool to be brazed. The sintered carbide blank to be brazed in place is merely laid onto the shank and after the proper heat has been obtained the blank is firmly pressed onto the shank —all controlled under a hydrogen atmosphere. Illustrated. Firth-Sterling Steel Co., McKeesport, Pa. (950)

Sicromo Steel

High temperature data sheets containing full information on this steel have been issued by The Timken Steel & Tube Co., Canton, O. (951)

Application of Heat to Core Baking

A profusely illustrated booklet containing information resulting from research on the subject has been published by the American Gas Association, New York, N. Y. (952)

Ferrocarbo

This material containing both silicon and carbon combined in the form of silicon carbide acts as a graphitizer or softener when added to cast iron. The compound is broken up and the Si and C react vigorously with the Fe with an exothermic effect when the Ferrocarbo comes in contact with the molten Fe. The manufacturer claims that when Ferrocarbo is used with a properly adjusted charge, the fine graphite structure and high strength characteristic of a hard charge are combined with a high degree of machinability. Carborundum Co., Niagara Falls, N. Y. (953)

Drop Forgings

Characteristics, qualities and uses of drop forgings are discussed in an attractive book published by the Drop Forging Assn., Cleveland, O. (954)

Free Cutting Steel

An attractive booklet records fifteen years spent by the company's metallurgical department in research on the machinability of free cutting steels. Jones & Laughlin Steel Corp., Pittsburgh, Pa. (955)

Vanadium Facts

Another issue of this publication contains accounts of progress and performance in the field of alloy steels. Vanadium Corp. of America, New York, N. Y. (956)

Monel Metal and Nickel

Bulletin C-4 is devoted to the use of these metals in the manufacture of pharmaceuticals, fine chemicals and proprietary products. International Nickel Co., Inc., New York, N. Y. (957)

Fluxing, Deoxidizing and Hardening Alloys

Ajax alloys (phosphor copper, phosphor tin, nickel copper, manganese copper and silicon copper) are the subjects of a new leaflet issued by the Ajax Metal Co., Philadelphia, Pa. (958)

Sand Control in the Foundry

A colorful pamphlet lists the major causes of casting defects and inferiorities and states that they may be avoided by the use of the proper sand control equipment. Illustrated. Harry W. Dietert Co., Detroit, Mich.

Published by the same company: "The Core Maker"—a leaflet and "Deformation and Resilience Accessory for Universal Sand Strength Machine" —looseleaf data sheet. (959)

Value of Draft Control

Bulletin No. L-125 is devoted to the above subject and points out the proper value of the furnace draft and this company's control which consists of a draft switch, a damper motor and a manual station Illustrated. Shallcross Controls, Inc., Milwaukee, Wis. (960)

Spectrometric Equipment

Catalog D-221 is devoted to the above equipment. Basic theory and design are described as well as the various types of instruments. Illustrated. Bausch & Lomb Optical Co., Rochester, N. Y. (961)

What Scientists Say of Leitz Ultropak

Bulletin No. 17 describes the personal experiences and applications to which Ultropak has been placed by scientific workers in various fields. E. Leitz, Inc., New York, N. Y. (962)

Granite City Hi-Yield 1 and 2

This company offers two types of high elastic steel which may be ordered in the regular or corrosion resistant grade. These steels are recommended for use where abrasion resistance is required. Physical properties and a typical analysis are included. Granite City Steel Co., Granite City, Ill. (963)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (964)

MANUFACTURERS' LITERATURE

Enduro

Data on the welding of Enduro stainless steels are given in a colorful brochure. Electric arc, gas, spot and projection, seam, flash, atomic hydrogen welding and brazing and silver soldering are features of this discussion. A complete list of products is included. Illustrated. Republic Steel Corp., Massillon, O. (965)

High Temperature Insulation

For all types of heated equipment is the subject of an illustrated leaflet issued by Armstrong Cork Products Co., Lancaster, Pa. (966)

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (967)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections Available Forms and Shop Practice, has been published by The Dow Chemical Co., Midland, Mich. (968)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. It is claimed that this series represents the best straight cutting oils obtainable, at a price which meets and beats competition. E. F. Houghton & Co., Philadelphia, Pa.. (969)

Electric Furnaces

A pamphlet describes the "Certain Curtain" furnace which was developed for heat treating at temperatures between 1850 and 2500 deg. F. C. I. Hayes, Inc., Providence, R. I. (970)

Electric Welding Products

Catalog No. 101 contains information on welding rods (recommended uses for the different types, physical properties, welding procedure, etc.); miscellaneous apparatus, and Wilson arc welding machines. Air Reduction Sales Co., New York, N. Y. (971)

Duraloy

Chrome-nickel and chrome-iron alloy groups with recommended applications are listed in a new pamphlet from this company. Centrifugal castings and recuperators are discussed and a table of the characteristics of various Duraloys is included. Illustrated. Duraloy Company, Pittsburgh, Pa. (972)

A. W. 70-90

This bulletin describes the new high-strength "70-90" steel in sheets and plates. An article on the engineering aspect of high-strength sheet steels is included. Alan Wood Steel Co., Conshohocken, Pa. (973)

Polishing Machines

A portable model and a floor model of these new metallographic machines are described and illustrated in a pamphlet from Eberbach & Son Co., Inc., Ann Arbor, Mich. (974)

Forging Rolls

Bulletin No. 91 claims that these wide adjustment forging rolls are completely modernized machines with improved mechanical operation, increased economy and efficiency of this forging method and improved quality of the product. They are built in six sizes which cover the field of forging that can be handled manually. Illustrated. Ajax Manufacturing Co., Cleveland, O. (975)

Industrial Furnaces

This catalog describes, illustrates and gives specifications for furnaces suitable for various applications. Mahr Manufacturing Co., Minneapolis, Minn. (976)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (977)

Phosphor Bronze

A leaflet lists the sizes in which the company's twelve-inch stock bushing bars are now offered. The Phosphor-Bronze Smelting Co., Philadelphia, Pa. (978)

Rocking Furnace

Type G-M is a small-scale indirect arc electric furnace designed for iron, steel, brass, copper and nickel alloy. The furnace is illustrated and specifications are included in a leaflet which has been prepared by the Detroit Electric Furnace Co., Detroit, Mich. (979)

Alloy Steels

A colorful folder devoted to these steels lists some of the advantages to be obtained by their use. Bliss & Laughlin, Inc., Harvey, Ill. (980)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (981)

Optical Pyrometer

The Burrell optical pyrometer, a direct reading instrument originally designed for use with the Barrett fusion furnace and equally useful for other work requiring an optical pyrometer with a temperature range from 1500 to 3000 deg. F., is described and illustrated in a leaflet published by the Burrell Technical Supply Co., Pittsburgh, Pa. (982)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (983)

Dolomite Refractories

This interesting pamphlet presents the case of Clinkered vs. Calcined Dolomite in the basic open-hearth steel furnace. Basic-Dolomite, Inc., Cleveland, O. (984)

Crucible Melting Furnaces

PDM Met-L-Melt furnaces for melting aluminum, brass, monel, nickel and iron, oil or gas fired, embody new design using the latest improved refractories, resulting in superior metal, low fuel consumption and melting speed, with long life of lining and crucibles, according to this company's Bulletin M-736. Philadelphia Drying Machinery Co., Philadelphia, Pa (985)

Aerocase

Booklet on this subject. Illustrations, curve charts, tables. American Cyanamid and Chemical Corp., New York, N. Y. (986)

Radium for Industrial Radiography

This article written by R. A. Gezelius and C. W. Briggs, containing interesting and important information on the subject, is published in handy booklet form. Radon Company, Inc., New York, N. Y. (987)

Special Atmospheres in the Heat Treatment and Brazing of Metals

A reprint of the above article by C. L. West, Research Engineer, is offered by The Electric Furnace Co., Salem, O. (988)

Inhibitor

Grasselli 3 inhibitor for efficient, economical pickling is the subject of a booklet of The Grasselli Chemical Co., Inc., Cleveland, O. (989)

Bimetal

A simplified version of its manufacture and the way it works is contained in this pamphlet. W. M. Chace Co., Detroit, Mich. (990)

Electric Arc Welding

The Manual for Training Operators contains very complete information on the subject. General information, theory of arc-welding, complete set of lessons and tests on the fundamentals of the metallic arc-welding process are some of the features. Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. (991)

Alloy Castings

Corrosion resistant and stainless steel castings are the subject of a new booklet. Chemical and metallurgical properties of these castings are included. Illustrated. Michiana Products Corp., Michigan City, Ind. (992)

Castings

Beryllium copper heat treated castings, either finished or unfinished, because of the fatigue, corrosion-resisting, high strength and unusually stable properties of this alloy, are offered to industry to fill the demand for better properties in cast parts, according to The Beryllium Corp. of Pa., Reading, Pa. (993)

Stainless and Heat Resisting Electrodes

A colorful price list and data book containing complete descriptions of the company's products and also analyses of stainless and heat resisting alloys manufactured by other companies has been issued by Maurath, Inc., Cleveland, O. (994)

3300 Deg. Super Refractory

An illustrated catalog devoted to "Shamva" Mullite contains information regarding its background, characteristics and uses. Mullite Refractories Co., Shelton, Conn. (995)

NEW EQUIPMENT AND MATERIALS

Korduct Is New Thin-Wall Form of Transite Conduit

"Transite Korduct," a new thin-walled companion to "Transite Conduit," has just been announced by the Johns-Manville Corp., 22 East 40th St., New York, after several months of development work which included a number of successful field installations.

Korduct, identical with Transite Conduit except in thickness, is an asbestoc-cement product formed under high pressure on a polished steel mandrel which assures an absolutely smooth inner surface. Transite Conduit was created more than two years ago to provide a conduit sufficiently strong and resistant to enable the laying of underground duct systems without a concrete protective envelope, and also to provide permanence in an electrical conduit used in exposed locations.

Korduct has now been introduced in its thin-walled form to enable the economical application of Transite's permanence and other inherent qualities to duct systems that are enclosed in concrete. Korduct is rot-proof and incombustible. It is immune to electrolysis and highly resistant to all forms of corrosion. Its rate of heat dissipation is high and cables are easily pulled through its smooth interior. This new material is recommended for use on all multiple duct transmission systems, in tunnels, bridge structures or dams, and wherever the service calls for concreting in.

Johns-Manville has prepared a new brochure containing complete engineering and technical data on both Transite Conduit and Korduct.

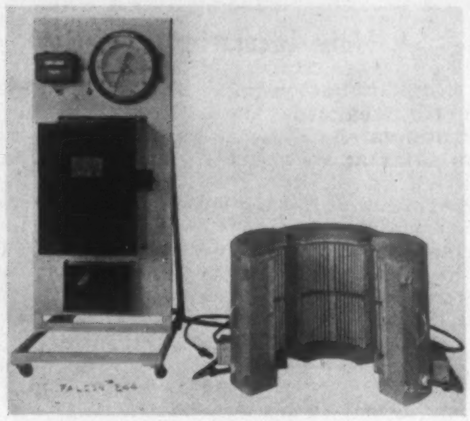
Another Falcon Electric Stress Reliever

Supplementing information which was published in the June, 1935, issue relative to "Falcon" portable electric heaters for stress relieving welded seams in pressure piping, nozzle attachments, etc., an additional type of "Falcon" heater now is being supplied to customers of H. O. Swoboda, Inc., Pittsburgh.

The heater is arranged in three sections for clamping together around the pipe to form a complete circular unit. This heater is suitable for pipe sizes 8 to 12 in. in dia. with maximum thickness of 1¼ in. The capacity of the heater is 27 kw. and it can be used on either 220 or 440 volts, 3 phase (one heater section per phase).

With the heaters are furnished portable automatic control panels for regulating and controlling the temperature during stress relieving and cooling. The control consists of contactor, transfer switch (for transferring to 220 or 440 volts or vice versa), push button, current input regulator for regulating the heating up and cooling off periods for various thicknesses of pipes and automatic recording control pyrometer for recording temperature and controlling same during stress relieving.

The heaters are provided with thermocouple location holes for inserting thermocouple for reading the temperature of the pipe at the weld during stress relieving. The heater is provided with plug type terminals; the control is supplied with 50 ft. length of flexible cable with plugs for connecting to heaters.



The heaters have a heating face of 22 in. in length to insure absolutely uniform stress relieving temperature in the pipe for a distance of six times the pipe thickness on each side of the weld and to allow the pipe temperature beyond said area to gradually diminish in order to eliminate the possibility of abrupt temperature differential between the hot and cold sections of the pipe.

Solvent Degreasing Machine

A new two-dip solvent degreasing machine, designated as size 624, has recently been added to the line of Detrex Degreasers manufactured by Detroit Rex Products Co., 13005 Hillview Ave., Detroit. Among the important features are a water jacket type of condenser completely encircling the machine, and a solvent condensate collecting trough located directly beneath the condenser. By this arrangement of the condenser and condensate collecting trough, the solvent vapors are held within the machine and all of the pure solvent distillate is emptied directly into the second or rinse chamber, thus continuously renewing the rinse chamber with pure solvent.

With this type of degreasing machine, the work is usually handled manually in baskets or on racks. For convenience, especially when comparatively heavy loads are cleaned, a small hoist may be employed. This machine is used for both immersion and vapor cleaning. The usual sequence of operations is to immerse the work in the boiling chamber, cool it in the clean solvent rinse, and finally suspend it for a few seconds in the pure solvent vapors over the boiling chamber. The work is removed clean and dry. This complete cycle of cleaning operations is accomplished in less than a minute and yet every trace of oil and grease is removed.

Either "Perm-A-Clor" or "Triad" stabilized chlorinated solvent is used in Detrex Degreasers. These solvents are non-inflammable and non-explosive and have a solubility factor for oils and greases more than four times that of ordinary organic solvents. The solvents are used over and over with but slight maintenance. The contamination resulting from the cleaning operation is removed from the solvent by periodic distillation within the machine. To facilitate this cleaning operation, there is an outlet from the solvent trough at one end. The unit is arranged for electric heating, using three immersion type heaters. These degreasers are also designed for steam or gas heating.

A Bright Zinc Deposit

A new and radically different type of zinc deposit, known as "Grasselli Bright Zinc," is announced by the Grasselli Chemical Co., Cleveland. In contrast to the old electro-galvanizing, in which in most cases the deposits of zinc were dull, gray and porous, this new process deposits zinc in a very brilliant, dense and ductile form.

The primary function of zinc deposits is to protect the underlying steel or iron from rust and corrosion. A rough porous coating which will hold moisture and easily collect dirt and foreign materials, especially microscopically small metallic particles, will discolor and deteriorate more rapidly than a dense, smooth plate, and, consequently, afford less protection against rusting and corrosion of the base metal than an impervious smooth deposit.

While appearance is often of secondary consideration, it is becoming more and more necessary to provide products with eye appeal. This is what Grasselli Bright Zinc does. It produces a very ornamental finish. Thus, one objection to zinc plating that has in the past ranked it inferior in the class of electro-deposited finishes has been overcome, and, at the same time, its value from a standpoint of rust prevention has been increased.

These improvements in the electro-deposition of zinc are largely the result of the use of molybdenum, a recent development of the same company. The use of molybdenum in the electro-deposition of zinc may parallel its use in stainless and alloy steels. In contrast to the old methods of electro-galvanizing, this new process operates at normal room temperatures, higher current efficiencies, high or low current densities, with a bright plating range from 15-100 amps. per sq. ft., and provides unusual economies.

Enamels To Protect Steel from Corrosion

A new line of air-drying enamels, especially designed to prevent the corrosion of iron and steel in railroad, marine, mining, oil, and general industrial service, has been developed by Maas & Waldstein Co., makers of lacquers and lacquer enamels, Newark, N. J.

These new anti-corrosive enamels are made of rust inhibiting pigments and a synthetic resin vehicle, and form a hard, tough coating that is resistant to wear and of pleasing appearance. Exposure tests, conducted for a long period of time, show that they are particularly effective in providing protection from the corrosive action of humidity, salt water, alkali, and a variety of chemicals, and in preventing electrolytic action, according to the manufacturer. A single coat gives adequate protection where the exposure is not prolonged or severe, but for maximum protection two coats are recommended.

These new enamels can be applied by either brush or spray. They air-dry in 4 hours, and are hard overnight. Types for baking for 1 hr. at 250 to 350 deg. F. can also be supplied. They cover approximately 350 ft. per thinned gallon. Available colors are brown, black, red, and a bronze liquid, which serves as a vehicle for aluminum and other metallic powders.

Electrolytic Production of Metallic Manganese

The first report of the electrometallurgical laboratory of the Bureau of Mines, Department of the Interior, soon to be issued, will disclose the development of a method for the production of metallic manganese from its ores by leaching and electrolysis. The pure metal so produced is in the form of bright, coherent sheets perfectly stable in air. The electrolyte used is manganese sulphate, since this is the most convenient form in which to obtain manganese by leaching. The secret of success is an ingenious method of maintaining an absolutely constant acidity of the electrolyte. The process is simple and cheap and adaptable to commercial utilization.

It is estimated that the power requirements for electrolytic precipitation will not be more than 4,000 kw.-hr. per ton of manganese. With large manganese deposits located within reach of power from Boulder Dam and other Federal projects, the power cost of producing high-purity manganese metal from the sulphate electrolyte obtained by leaching may be as low as $10 a ton.

A New Insulating Material

Consummation of a selling arrangement whereby the Armstrong Cork Products Co., Lancaster, Pa., will act as sales agents in the equipment insulation field for the Corning Glass Works' new highly refined wool insulation consisting of long, interlocked glass fibres, is announced by L. E. Cover, manager of Armstrong's equipment insulation sales department. Armstrong will sell this efficient material under the trade name of "Armstrong's Wool Insulation" and it will be furnished in the form of sealed packages, blankets, fold-bats, and in bulk or loose form for use as a fill insulation.

Included in the field to be served by Armstrong will be manufacturers of refrigerators and refrigerated equipment, refrigerator and passenger railway cars, refrigerated truck bodies and passenger automobiles, stoves, and equipment for the oil, steel, and other industries. The material also will be sold by Armstrong for industrial duct insulation and other industrial equipment.

Tests made by the Armstrong research laboratories show that the insulating wool, made by Corning Glass Works, possesses unusually low thermal conductivity, ranging, in the commercial densities, from 0.23 B. t. u. to 0.26 B. t. u. hr. deg. F. at 90 deg. F. mean temperature. Especially long, intertwined fibres give the insulating wool blankets strength. Since the insulation holds together, it will not shake down or settle under extreme vibration. Depending on the temperature requirements the new wool insulation can be furnished in forms weighing from 1½ to 6 lbs. per cu. ft.

New Brazing Alloy Increases Applications

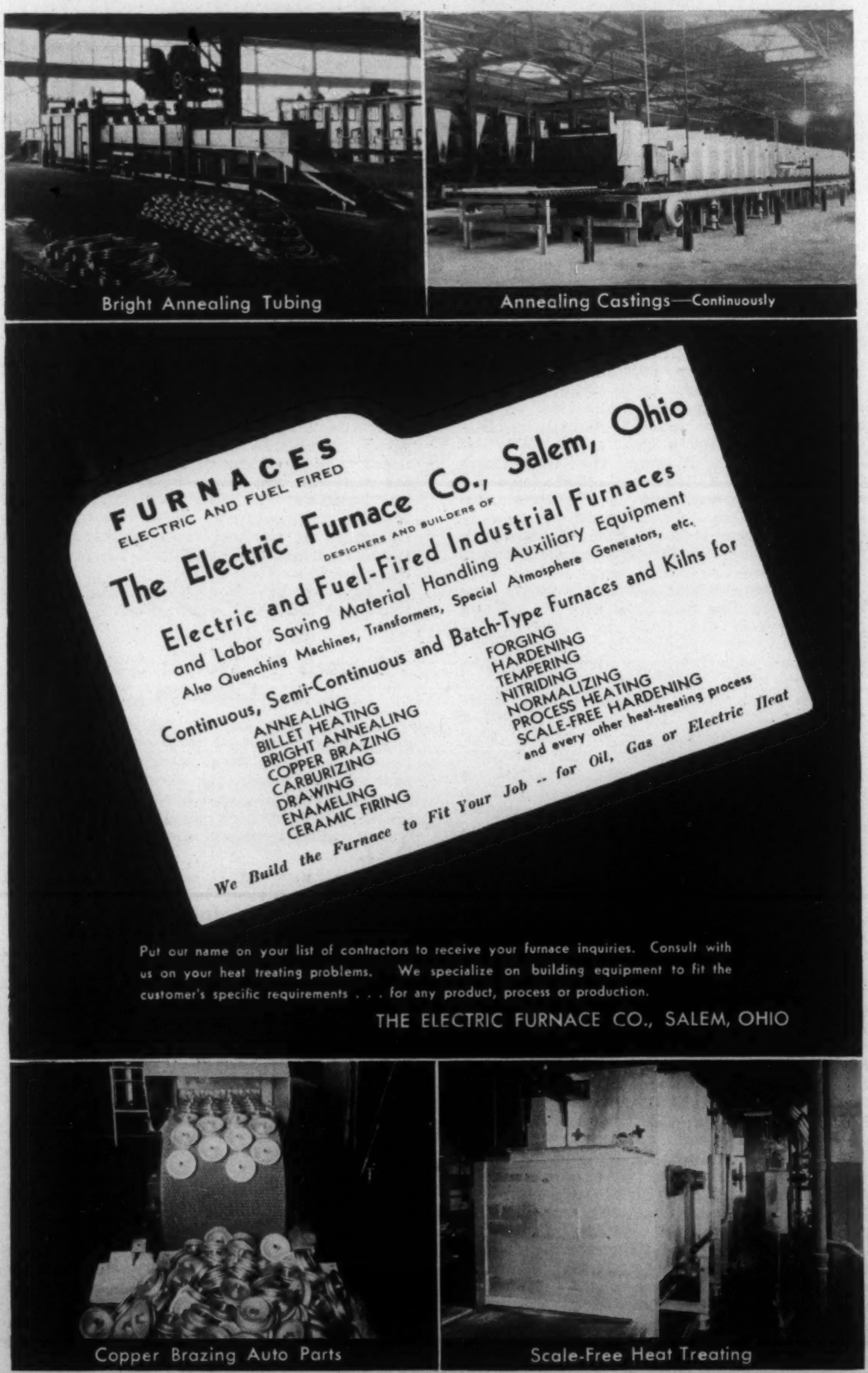
Improvements and refinements in manufacturing "Phos-Copper" brazing alloy have been announced by the Westinghouse Electric & Mfg. Co. Increasing its field of application, the new processes include annealing and pickling to insure freedom of any carbonaceous deposit on the surface which might interfere with the production of leak-proof joints. This makes the new alloy especially suitable for applications such as refrigerator parts where leak-proof joints are a necessity.

An alloy of phosphorus and copper developed to replace expensive silver solders, Phos-Copper has a relatively low melting point, high tensile strength and excellent penetration. Some of its other desirable properties include absolute uniformity of alloy, self fluxing properties for most applications, high ductility, high fatigue resistance, high corrosion resistance, high electrical conductivity, high fluidity at brazing temperature, and economical to use. Also, brazed joints may be electroplated or tinned.

Phos-Copper is available in many sizes and shapes, including rod, ribbon, washers, strip, and other shapes. Standard rods are 3 ft. in length with diameters as follows: 1/16, 3/32, 1/8, 3/16 and 1/4 in. Ribbon is 0.015 in. thick by 1.25 in. wide. Other shapes for special applications are available.

It is applicable to all kinds of copper and copper alloy joints where strength, or gas and liquid tight joints are required, such as bus bar structures, copper tanks, cooling coils, electrical connections radiators, refrigerators, terminal lugs, water heaters, copper piping, air conditioning systems, and copper smithing.

Phos-Copper is applied essentially the same as soft solders, except that it requires a higher temperature. It melts at 707 deg. C., a temperature which can easily be obtained by an oxy-acetylene torch, incandescent brazing or carbon arc. High fluidity at brazing temperatures makes the alloy easy to use. At brazing temperatures it flows freely over the surface, facilitating the brazing of hard-to-get-at joints. It is self fluxing when used on ordinary copper work where it is not necessary to secure gas or liquid tight joints.



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Scale-Free Heat Treating

Parker Launches Zinc Bonderizing Process

Working behind closed doors, research workers of the Parker Rust Proof Co. in Detroit have been testing, experimenting and retesting a new Parker process. They have just made the announcement that they have perfected a new process and are satisfied with their tests. The new process is called Bonderite "Z." This latest Parker process is claimed to prevent corrosion and to stabilize paint finishes on zinc-alloy die-castings and galvanized and galvanealed iron. Like the other now famous Parker processes, it is a low-cost, easily applied, chemical conversion process that both coats and alters the surface of the metal.

Metallurgists, designers, sales engineers and executives who have seen the results of tests with the new Bonderite "Z" process are reported to unite in agreeing that it will open the door to new sales opportunities and new markets for many manufacturers, such as producers of zinc die-castings. These require little or no machining and finishing, can be more easily cast into intricate shapes, and usually can be produced in quantities more economically. Galvanized and galvanealed iron, too, have long been considered the ideal materials for countless stampings, linings and other parts or products that are to be subjected to long and hard use.

Nevertheless, these materials have been kept out of some markets because of corrosion difficulties and poor paint-holding qualities. But now, with the development of the Bonderite "Z" process that prevents corrosion and gives them a substantial base for paint, zinc and galvanized iron can step into these markets. Bonderite "Z" is claimed to greatly extend their already wide sales fields.

Technically, Bonderite "Z" is a chemical conversion process. It converts the metal's smooth surface into an absorbent, paint-holding, crystalline structure and produces an insoluble phosphate salt coating that becomes an integral part of the metal itself. It may be applied to zinc-alloy die-castings, stampings, forgings and rolled or machined parts and galvanized or galvanealed parts of any size or shape. Its effectiveness is best demonstrated on parts having recesses, depressions or internal threads. It contacts all surfaces equally, converts the metal, and deposits its protective coating in every crevice and corner. Because it is a chemical conversion process, and because it is applied at comparatively low temperatures, Bonderite "Z" does not change the size, shape or contour nor does it distort or warp the production treated. Like Bonderite "B" and "X," and its other related processes Bonderite "Z," requires comparatively simple equipment, is easily applied, and is inexpensive. It requires no electric current. Besides ordinary cleaning and rinsing tanks, the only other equipment needed is a processing tank of sufficient size—and trays, baskets or hooks in sufficient quantity—to handle the daily production requirements.

Bonderite "Z" can be applied without expert supervision. Parts to be treated are simply cleaned, immersed in the processing tank ½ to 3 min., removed, rinsed and dried. It comes in concentrated liquid form which requires only the addition of water to prepare the working solution. A simple titration indicates the concentration of the processing solution which can easily be kept at the proper working strength by the addition of the concentrated Bonderite "Z" chemical. The entire process, including chemicals, labor, and write-offs on equipment, adds but a fraction to the total cost of any product.

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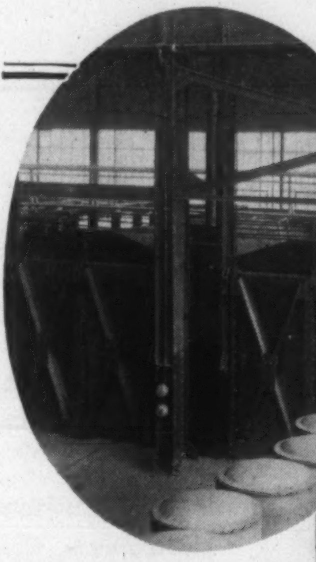
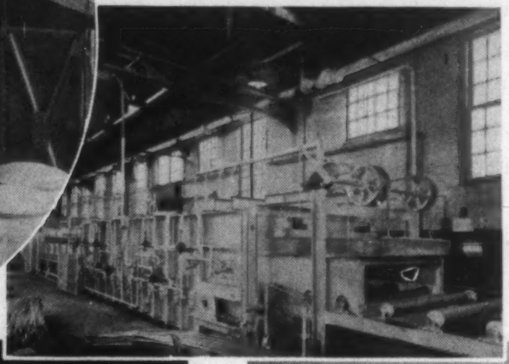
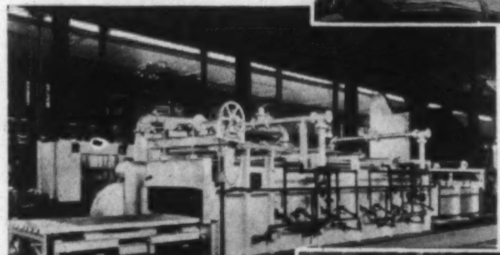
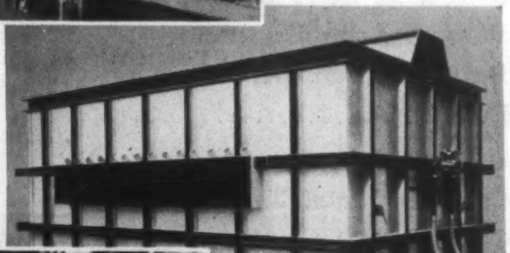


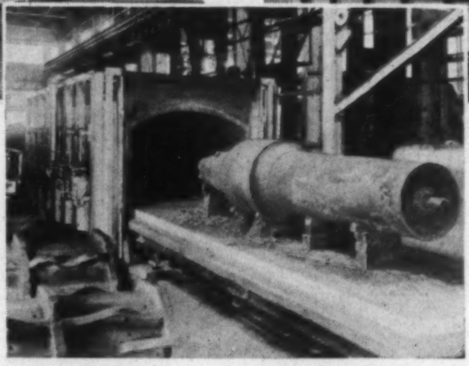
LEFT—
RUST *of Pittsburgh built a battery of these box annealing furnaces for the Wheeling Steel Corp., and insulated them throughout with Armstrong's N-16 Insulating Brick for accurate temperature control and operating economy.*



LEFT—
ROCKWELL *insulated this gas-fired, continuous, controlled atmosphere, brass annealing furnace with Armstrong's EF Insulating Fire Brick. The result is efficient operation with uniform temperatures.*







ABOVE—
SURFACE COMBUSTION *knows the value of efficient insulation to prevent waste of heat. That's why this normalizing furnace, like many others built by this Toledo Company, is insulated with Armstrong's High Temperature Products.*

SWINDELL-DRESSLER *report fuel savings of 65% with this gas-fired, car-type annealing furnace which they built for a Pittsburgh manufacturer. Insulation is 9" Armstrong's EF-22 Insulating Fire Brick backed up with 9" Armstrong's N-16 Insulating Brick.*

ABOVE—
LEE-WILSON, *furnace builders of Cleveland, Ohio, insure uniform distribution of heat in this vertical-tube annealing cover by insulating it with Armstrong's N-20 Insulating Brick.*

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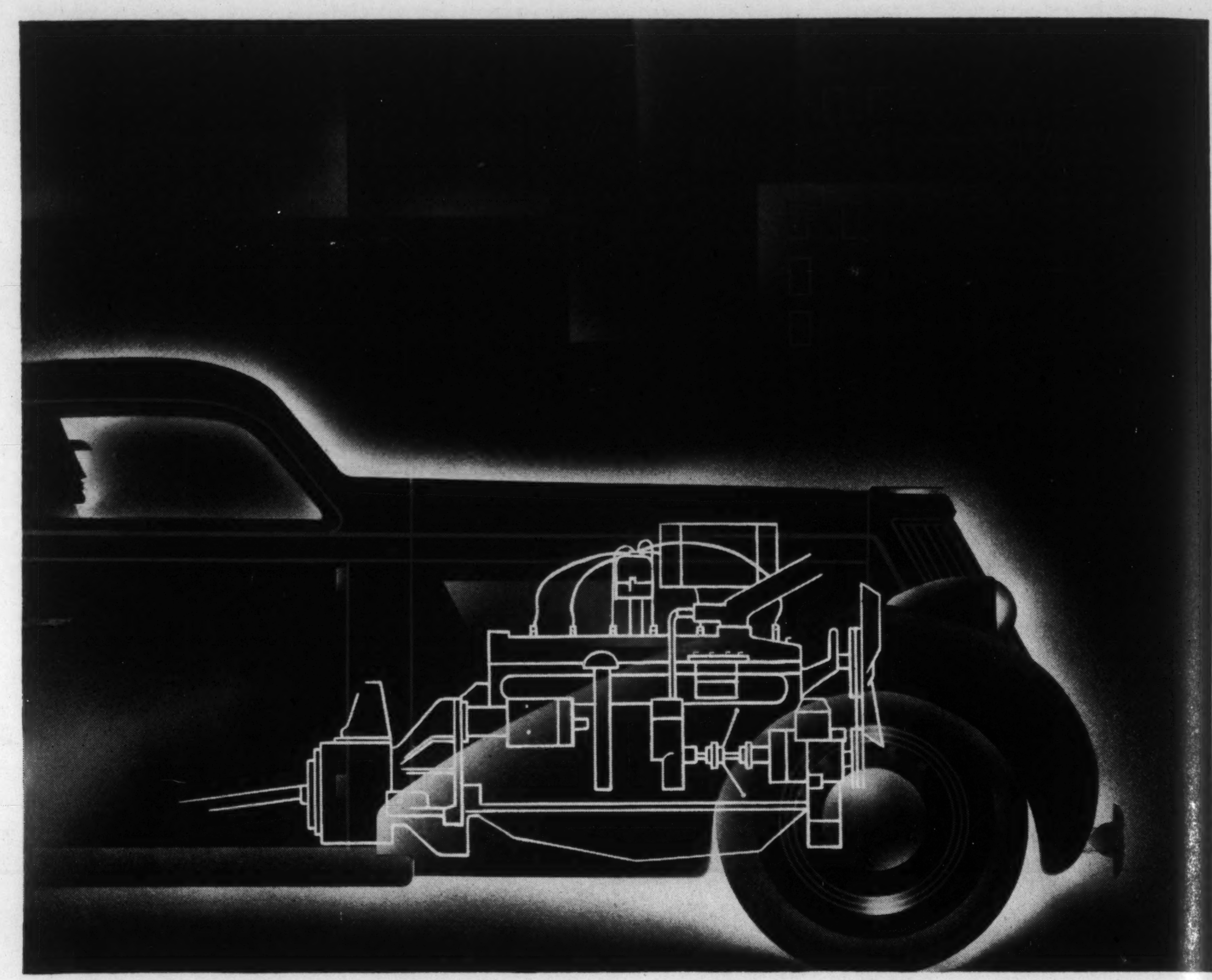

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CUTS COSTS

CREATES SALES

1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Gold Ore from Island Mountain, Wells, Cariboo District, B. C. W. B. Timm et al. *Canada Department of Mines, Mines Branch, Report* No. 748, 1936, pages 6-15. Amalgamation failed to recover Au; jigging effected no concentration. Flotation of an 0.84 oz. ore gave a 3.08 oz. concentrate at 88% recovery. Cyanidation extracted up to 97%. **Gold-Silver Ore from Kozak Mine, Algoma District, Ontario.** Pages 16-20. Maximum recovery is secured by flotation at 90% —200 mesh. Cyanidation gives a higher Au recovery but Ag losses are much higher. **Gold Ore from Bosquet Gold Mines, Limited, Sudbury, Ontario.** Pages 21-28. Good recovery can be obtained by any one of a number of standard flow sheets. **Gold Ore from Bluenose Gold Mining Company, Limited, Stormont Township, Guysborough County, N. S.** *Ibid.*, pages 29-37. For a small mill, stamp to 35 mesh, amalgamate, table the tailings, discard sand, thicken and float slimes. Amalgamation recovers 71.25% of the Au, tabling 11.75% and flotation 15.7%; recovery after extraction is 95%. For a large plant, ball mill to 60% —200 mesh, amalgamate and cyanide tailings. Overall recovery is over 95%. **Gold Ore from the Canadian Malartic Mines, Limited, Abitibi County, Quebec.** Pages 38-45. Working with an ore assaying 0.22 oz. Au/ton, low recoveries were obtained by amalgamation or flotation alone or in combination with traps, blankets or amalgamation plates. Cyanidation of 50-60% —200 mesh pulp gives 88-90% extraction. **Gold Ore from Stadacona Rouyn Mines, Limited, Rouyn Township, Témiscaminque County, Quebec.** Pages 46-49. Maximum recoveries (95%) are obtained by cyanidation of —150 mesh ore for 48 hrs. **Gold Ore from Rice Lake Gold Mines, Limited, Manitoba.** Pages 50-52. From 60 to 70% of the Au is recovered by amalgamation; 97% is extracted by 48 hrs. cyanidation of —150 mesh ore. Grinding, discharge over a blanket, amalgamation of the concentrate and thickening and cyanidation of the tailings is recommended. **Gold Ore from the Queen Mine, Sheep Creek Gold Mines, Limited, Salmo, B. C.** Pages 53-60. Tests by amalgamation, flotation and cyanidation in various combinations are reported. Fine grinding is necessary. Cyanidation, giving 98% extraction, is the most satisfactory. **Arsenical Gold Ore from Minto Gold Mines, Limited, Bridge River District, British Columbia.** Pages 61-71. Straight cyanidation or concentration by flotation and blanketing with smelting of the concentrates gave 85-90% recovery. **Gold Ore from Grandoro Mines, Limited, Penticton, B. C.** Pages 72-76. Amalgamation recovered 75%. Cyanidation at 45% —200 mesh for 24 hrs. gave 97.5% extraction with low reagent consumption. Flotation recovered 97.32% of the Au, but overall recovery after cyanidation of the concentrate was 81%. **Ore from Central Patricia Mines, Limited, at Pickle Lake, Ontario.** Pages 77-80. Pyrrhotite in the ore greatly reduces cyanide extraction. Grinding in alkaline solution, followed by aeration for 6-8 hrs., gives 92-96% extraction. **Gold Ore from the Porcupine Peninsular Gold Mines, Limited, Timmins, Ontario.** Pages 81-86. Maximum recoveries are obtained by 48 hrs. cyanidation of 93% —200 mesh ore. Flotation of 44% (or 95%) —200 mesh ore recovers 90% of the Au; cyanidation of reground concentrate gives 83% overall recovery. **Ore from the Wendigo Mine, Near Kenora, Ontario.** Pages 87-94. Cyanidation is unsuitable due to high Cu content. At 60% —200 mesh, over 70% of the Au is caught on blankets and 20% recovered in a flotation concentrate assaying 20% Cu and 2-2.5 oz. Au. Plate amalgamation recovers 60% and flotation 30% more. **Ore from the Kilo Mine, Near Slocan City, B. C.** Pages 95-105. From 85-98% of the Au is recovered on blankets. Amalgamation of the concentrate after 93% extraction gives a minimum recovery of 79%. Use of amalgam plates with the blankets gives overall recovery of about 90%. Recovery can be increased by treatment of the 4-oz. tailing. Cyanide extraction was 95%. **Ore from the Arntfield Gold Mine, at Arntfield, Quebec.** Pages 106-110. Cyanidation, perhaps with tabling and regrinding of the sulphides, is the most practical; over 95% extraction is obtained. **Gold Ore from Pontiac-Rouyn Gold Mines, Limited, Rouyn Township, Quebec.** Pages 111-116. Cyanidation of —200 mesh ore for 24 hrs. gave 93% extraction with low reagent consumption. Blanket concentration followed by flotation gave 93.5% recovery. **Gold Ore from God's Lake Gold Mines, Limited, God's Lake, Manitoba.** Pages 117-125. Cyanidation is satisfactory; there are certain advantages in using blankets, jigs or traps in closed circuit with the mill and classifier. **Gold-Silver-Lead Ore from the Marysville Mining Company, Limited, Fort Steele Mining Division, B. C.** Pages 126-133. The highly altered condition of the minerals makes concentration difficult; a 2-stage process is necessary. Tabling gives a concentrate containing galena and Au. The tailing, consisting largely of $PbCO_3$, requires sulphidizing prior to flotation. Cu is difficult to concentrate. About 90% of the Au and 80% of the Ag are recovered by tabling and flotation. **Gold-Copper Ore from Tashota Goldfields, Limited, Tashota, Ontario.** Pages 134-140. Blankets between the grinding mill and the classifier recover 50-65% of the Au; barrel amalgamation recovers 98% of the Au in this concentrate. Flotation of the tailing with depression of pyrrhotite and pyrite with lime, gives a concentrate containing 19% Cu and 2.69 oz. Au and a tailing assaying 0.075 oz. Au; this can be reduced to 0.01 oz. by cyanidation. Overall Au recovery is 97% and Ag 98%. **Copper-Gold Ore from the Sunset and Mother Lode Mines, Boundary District, B. C.** Pages 141-151. Ball milling to 75% —200 mesh, aeration of the classifier overflow for 20 min., rougher flotation, cleaning, and regrinding and return of the middling gave 90% Cu and 85% Au recovery in a 20% Cu and 0.80 oz. Au concentrate. **Gold Ore from the Reno Gold Mines, Limited, Salmo, B. C.** Pages 152-158. Amalgamation of a blanket concentrate gave 53.6% Au recovery; cyanidation gave 39-45% more. Very fine grinding was not beneficial. Pre-aeration will lessen the cyanide consumption by pyrrhotite. **Gold Ore from the Powell-Rouyn Gold Mines, Limited, Rouyn Township, Quebec.** Pages 159-164. Cyanidation preceded by trapping of coarse Au is most suitable. **Gold Ore from the Hudson-Patricia Gold Mines, Limited, Narrow Lake, Ontario.** Pages 165-170. Cyanidation extracts 98% of the Au; traps should be used. **Gold-Silver Ore from the Monashee Mines Syndicate, Limited, Vernon, B. C.** Pages 171-178. Cyanidation of ore ground 70-80% —200 mesh gives 96% extraction of Au and 83.4% extraction of Ag with normal reagent consumption. Barrel amalgamation of a blanket concentrate (100-130 oz. Au/ton) followed by flotation of the tailing gives an overall recovery of 94-95% of the Au and 90% of the Ag. **Arsenical Gold Ore from the Hedley Mascot Mine, Hedley, British Columbia.** Pages 179-190. Good results were obtained by cyanidation followed by flotation of the tailings. Due to the high As content, the concentrate can be sold to a smelter equipped to handle it, roasted and cyanided, or reground to —325 mesh and cyanided.
AHE (1)

1a. Crushing, Grinding & Plant Handling

Heavy Fluid Separation—New Efforts Offer Promise. F. J. Tolonen. *Engineering & Mining Journal,* Vol. 137, Feb. 1936, pages 91-92. Recent development in the use of heavy liquids in the preparation of minerals has been in 2 general fields: (1) where the media are heavy liquid chemicals, or solutions having a high sp. gr., and (2) where they consist of suspensions of more or less finely divided solids in water. The flowsheet for one application to Fe ore and on Cu rock is shown. Heavy fluid processes may be used for preliminary enrichment of feed.
WHB (1a)

1c. Flotation

Critical Observations of Mineral Behavior When Associated with Superheated Water. Arthur J. Crowley. *Engineering & Mining Journal,* Vol. 137, Jan. 1936, pages 27-30. This phenomenon is believed to function importantly in the processes of mineral depositions. A S liquefier is described and illustrated that permits the production of a 99.5% S from 86% S flotation concentrate from Nevada ores. It seems likely that similar conditions have existed in the past in Nevada, Utah and California which may have caused the formation of the S deposits.
WHB (1c)

New Methods for Treating Gold Bearing Ores (Les nouvelles méthodes de traitement des minerais auriferes) Ch. Berthélot. *Revue de Métallurgie,* Vol. 33, May 1936, pages 291-294. The present general tendency in handling Au ores is to recover as much Au as possible in the first stages of the processes. Xanthates mixed with other collectors appear to be the most used. JDG (1c)

The Bubble Machine for Flotation Testing. Guido R. M. Giudice. *Engineering & Mining Journal,* Vol. 137, June 1936, pages 291-294. With a modification in construction and a changed technique of use, the results obtained with this machine in measuring contact angles are now readily reproducible. The bubble machine measures contact angles at the line of 3-phase contact: air or oil, mineral, and water. The arrangement of the apparatus is shown diagrammatically.
WHB (1c)

1d. Magnetic Separation

Experiments Upon Magnetic Dressing of Brown Hematite Ores of Lower Silesia (Versuche zur magnetischen Aufbereitung von niederschlesischem Kaseneisenerz) W. Luyken & L. Kraeber. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 18, No. 4, 1936, pages 35-41. Experiments are reported to find means for concentrating high SiO_2 ores to reduce the great amount of lime additions necessitated by this condition and the consequently large amount of slag. Magnetic separation of part of the SiO_2 which occurs in form of small quartz grains was possible, but this yielded a concentrate of only 39.2% Fe with a total yield of Fe of 83%. After roasting the ore to ferromagnetic Fe oxide, however, a concentrate of 49.7% Fe with a yield of 83.3% Fe could be obtained, and this was still further improved, by crushing the intermediate sized grain, to 50% concentrate and yield of 88.7% of the total Fe. Under the existing conditions, magnetic concentration can be recommended for the Fe-poor parts of the ore while the richer ores may be dried only. The influence of grain size is shown by test runs.
Ha (1d)

1e. Amalgamation, Cyanidation & Leaching

The Oxygen Content of Cyanide Solutions. F. J. Tromp & W. E. Schilz. *Journal Chemical, Metallurgical & Mining Society of South Africa,* Vol. 36, Jan. 1936, pages 195-197. Discussion. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 434L/7.
AHE (1e)

The Re-treatment of Cyanide Tailings from the Golden Horseshoe Mine. T. B. Stevens. *Bulletin Institution of Mining & Metallurgy,* No. 378, Apr. 1936, 12 pages. The tailings are sluiced by a monitor using spent solution and pulp. Recirculating a percentage of pulp makes use of a thickener unnecessary. Most soluble Au is dissolved in the sluicing circuit, so little agitator capacity is needed. In the agitators, cyanide concentration is 0.015%, derived from the spent solution; before precipitation it is brought up to 0.03%. Consumption of cyanide is 0.54 lb./ton treated. Solutions must be kept nearly neutral to prevent precipitation of Mg salts in the precipitation plant. Lime consumption is 1.2 lb./ton. Bullion contains Au 62, Ag 33 and base metals 5%. The plant is described.
AHE (1e)

The Solubilities and Free Energies of Some Metallic Sulfides. S. Frederick Ravitz. *Journal of Physical Chemistry,* Vol. 40, Jan. 1936, pages 61-70. The values recommended for the standard free energies of formation, the solubility products and the solubilities in H_2O of the metallic sulphides are given. 33 references.
EF (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

Thermodynamic Approximation Calculations (Thermodynamische Näherungsrechnungen) Paul Drossbach. *Metall und Erz,* Vol. 33, Apr. 1936, pages 173-177. The approximation equation $\Delta Z = Q_1 - T\Delta S$, is discussed, and its application to several examples illustrated, among them the decomposition potential of Pb chloride and lime, and the reduction of Zn oxide and Fe oxide. FPP (2)

2a. Non-Ferrous

Zinc and Lead Recovery from Shaft Furnaces Slags at Trail (British Colombia) (Récupération du zinc et du plomb des laitiers de hauts-fourneaux à Trail (Colombie Britannique)) G. Murray. *Revue de Métallurgie,* Vol. 33, May 1936, pages 309-313. Abstract of a paper delivered at the 7th Congress of Mining & Metallurgy in Paris. Coal dust is blown into molten slag. C reduces oxides contained in it and excess of air oxidizes them into fumes which are recovered in gas houses. Daily recovery averages 100 tons. Full description is given in *Transactions of Canadian Institute of Mining & Metallurgy,* Vol. 34, 1933, pages 75-103. JDG (2a)

Making Alumina by the Seailles Process (La fabrication de l'alumine par les procédés Séailles) *Journal du Four Electrique,* Vol. 45, May 1936, pages 162-163. Al bearing materials are sintered at 1000°-1150° C. with $CaCO_3$ and leached with water. Leaching is feasible because at 30° C. calcium aluminates do not set. $CaCO_3$ and alumina are precipitated by CO_2. $CaCO_3$ can be removed from the mixture by treating with CO_2 charged water which removes Ca as bicarbonate. Or Al can be removed with soda. Anhydrous Al_2O_3 precipitates in the process, which permits utilization of siliceous bauxites, completely prevents soda losses and reduces expenses for heat generation and labor. JDG (2a)

Electrolysis of Aluminum Sulphide. E. I. Khazanov & A. I. Belyaev. *Legkie Metallui,* Vol. 4, Nov. 1935, pages 1-14. In Russian. Al_2S_3 was electrolyzed in a solution of 70% NaCl and 30% Na_3AlF_6 at 800° C. A maximum current efficiency of 55% was obtained. Addition of Al_2O_3 to the electrolyte did not influence the efficiency but the addition of FeS sharply reduced the efficiency. HWR (2a)

Beryllium. Robert Gadeau. *Aluminium & the Non-ferrous Review,* Vol. 1, May 1936, pages 353-360. See *Metals & Alloys,* Vol. 7, June 1936, page MA 279L/5. JCC (2a)

Mercury in Germany (Deutsches Quecksilber) E. Reitler. *Chemiker Zeitung,* Vol. 60, May 2, 1936, pages 365-367. Germany's position in the world's production and consumption of Hg is discussed, and the composition, occurrence and extraction of Hg ores, and current uses of the metal are described in some detail. FPP (2a)

2b. Ferrous

Overblowing in Blast Furnace Practice. Wm. McConnachie. *Blast Furnace & Steel Plant,* Vol. 24, May 1936, pages 403-405. Using data presented by J. Gayley in *Journal of the Iron & Steel Institute,* 1890, pt. 2, discusses reasons for increased fuel consumption when overblowing. Concludes that poor results must be attributed to the fact that extra blast has thrown more work on furnace, in that more crude Fe is reoxidized, and that proportionately more cyanide is oxidized, thus throwing a further amount of work on furnace, while simultaneously depriving it of a most useful reducing agent. Every effort should be made to utilize reducing power of the alkali cyanides to the fullest extent. This can be effected by abandoning idea of a more thorough distribution of blast by increasing number of tuyeres and realizing that a large proportion of stock does not pass through combustion zone, so must depend on deriving necessary heat in an indirect manner. It is advisable to keep number of air inlets down, and by overhanging tuyeres so to arrange for as great an area as is practicable in which the very powerful reducing vapors, generated below tuyere level, can rise among the materials without interference by the blast. This will permit greatest amount of O_2 removal, on which furnace pace depends, much more than on amount of heat produced, or on temperature attained in combustion spaces. MS (2b)

Speed of Dissociation of Carbon Monoxide in the Presence of Iron and Its Oxides (Sur la vitesse de dissociation de l'oxide de carbone en presence du fer et de ses oxydes) Francis Meunier. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 258-264. Speed of decomposition of CO as a function of temperature and rate of flow was investigated. Traces of moisture badly affect equilibria, reaction taking place very rapidly. At all temperatures C precipitation drops very rapidly with the reduction of the time of contact. With the same speed of flow a sharply marked maximum occurs at about 500° C. at atmospheric pressure. There was total absence of C precipitation in passing CO over Fe_2O_3 at 350°-600° C. before elimination of 11.1% O. At the same temperature, precipitation with time is much slower than reduction. Dissociation is very fast as soon as all metal is reduced. The amount of Fe_2O_3 reduced is a direct function of C precipitated. JDG (2b)

Making Ferro-Alloys from Ores in Electric Arc Reduction Furnaces (Fabrication des alliages de fer en partant des minerais par emploi de fours de réduction à arc électrique) Alfred Karsten. *Revue de Métallurgie,* Vol. 33, May 1936, pages 345-347. A superficial description of furnaces and processes, mostly used in Russia. JDG (2b)

3. MELTING, REFINING AND CASTING

The Dumbarton Valve Works of Babcock & Wilcox, Limited. *Foundry Trade Journal,* Vol. 54, Feb. 6, 1936, pages 119-121, 130. The manufacture of boilers for high pressures introduced an entirely new set of factors, calling for the installation of special machines and plant as also for the evolution of a new range of boiler fittings, more particularly valves. To meet the new conditions radical departures had to be made alike in design, material and constructive methods. To insure the absolute uniformity of production, which is an essential, careful consideration was given to the design of jigs, fixtures and gages. The calorizing shop is a separate block of buildings, where a number of different processes are used for the impregnation of certain of the ferrous components with Al. In the non-ferrous foundry are produced bronze, gunmetal and Ni-alloy castings. The paper is well illustrated with pictures showing different parts of this plant. AIK (3)

3a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

The "Modifying" Phenomenon and Its Probable Relation to Properties of Non-Ferrous Alloys. C. H. Lorig & R. W. Dayton. *Transactions American Foundrymen's Association,* Vol. 7, Feb. 1936, pages 262-268. The adding of certain deoxidizers and degasifiers to alloys may lead to the destruction of crystal centers or to the creation of new centers, to the spontaneous crystallization of the alloys in the supercooled state or to normal crystallization, and finally to wide variations in the properties of a given alloy. Cast metals are particularly susceptible to the above mentioned modifying action when it occurs. The few isolated examples of non-ferrous alloys deliberately modified either with modifiers, by super-heating or by chill casting show the vast possibilities of utilizing the modifying action to good advantage. The "silicate-slime" or "slag cloud" hypothesis which states that minute inclusions of some types act as nuclei for crystallization was developed to explain graphite formation in cast Fe. The authors review the work of various investigators in both the ferrous and the non-ferrous fields and explain how the theories mentioned might be applied to non-ferrous cast alloys to explain why alloys which are sound, reasonably free from contaminating metallic elements and of good manufacture sometimes possess irregular, if not totally dissimilar properties. CEJ (3a)

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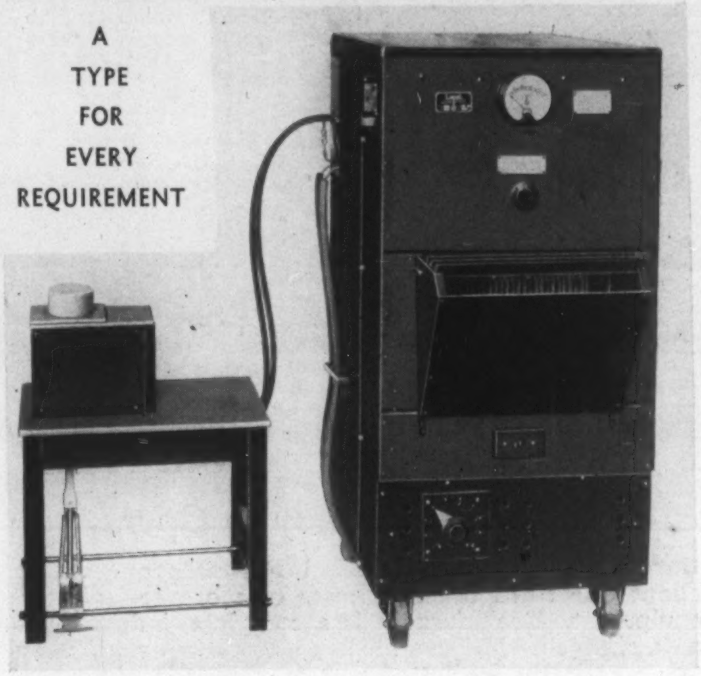

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3b. Ferrous

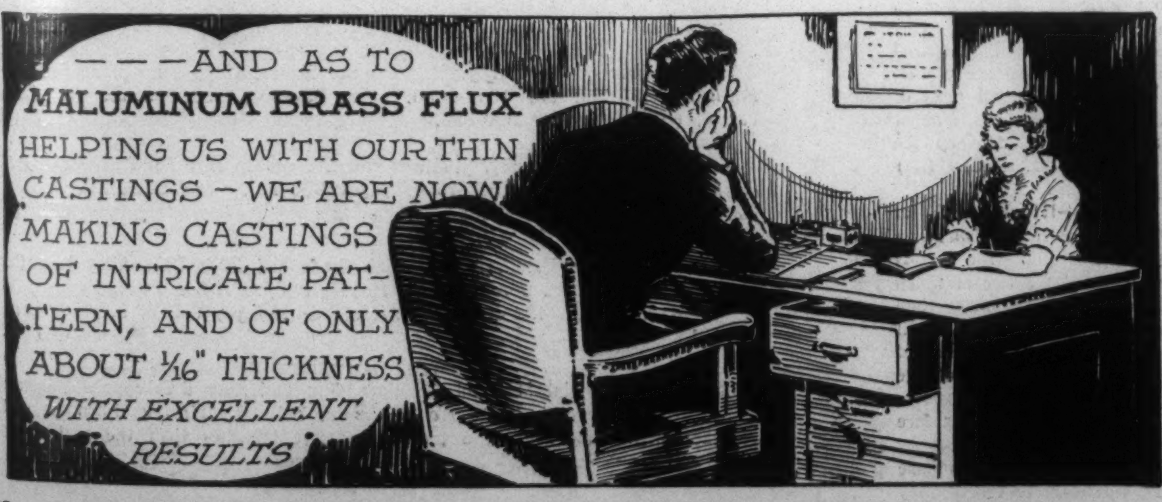
C. H. HERTY, SECTION EDITOR

Casting of Cast Iron in Chill Molds under Pressure (La Coulèe de la Fonte en Coquille sous Pression) L. J. GOUTTIER. *Revue de Fonderie Moderne,* Vol. 30, June 25, 1936, pages 199-208. Die casting of cast Fe is discussed; molds, equipment and means for producing air pressure and applying the latter in correct manner are described at length, in particular the Wetherill process. Methods for die casting of Pb, Sn, Zn, Mg, Al and Cu are briefly reviewed. Ha (3b)

Production of Sound Castings. T. R. HARRIS. *Iron & Steel Industry,* Vol. 9, June 1936, pages 370-374. Author deals with the production of sound castings in a jobbing foundry. There are a number of factors which can be controlled. Design can be modified to give a more even distribution of metal and insure a more uniform cooling of the metal throughout. The metal can be kept within close limits by using pigs of known qualities together with domestic scrap. Sand control can be reduced to ordinary routine practice. All details should be tabulated to avoid costly experimenting in the future. CMS (3b)

Alloy Cast Irons. P. A. RUSSELL. *Foundry Trade Journal,* Vol. 54, Mar. 19, 1936, pages 227-230. A paper presented to the Lancashire branch of the Institute of British Foundrymen. Thomas and Ballay recently suggested that the term "special cast iron" should be applied to cast irons containing one or more of the following elements in excess of:—Ni 0.3, Cr 0.3, Cu 0.3, Ti 0.15, V 0.10, Mo 0.10, Si 5.0, and Mn 1.5%, and that the term "High-grade cast iron" be applied to irons produced by special processes which do not contain the above alloys. Author does not agree with these terms. Principles of alloying, heat-resisting cast irons, corrosion-resisting cast irons, high-strength cast irons, etc. are discussed. It is pointed out that mechanism of the deterioration of cast Fe under heat is due to following factors:—(1) spread of internal oxidation via the graphite flakes; (2) breakdown of pearlite, with consequent setting up of internal strains which weaken the Fe, cause cracks, and thereby assist the spread of oxidation; and (3) general weakness of Fe due to high temperature *per se.* Heat-resisting cast irons can be classified as follows in order of increasing heat-resisting value; (1) Cr or Ni-Cr pearlitic gray cast irons (Cr 0.3—1.5, Ni 0.5—2.0%); (2) Cr white cast irons (Cr 0.5—1.5%); (3) Silal (Si 5—6%); (4) austenitic cast Fe of the Ni-Resist type (Ni 14—16, Cu 6—7 and Cr 2—5%); (5) Nicrosilal austenitic cast Fe (Ni 18—20, Si 4.5—5.5, Cr 2—4%). AIK (3b)

Problems of Iron Casting. N. G. HIRSHOVICH. *Liteinoe Delo,* Vol. 7, No. 4, 1936, pages 28-43. In Russian. Extended abstract of the literature of the first half of 1935. 84 references. (3b)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Developments in the Production of Malleable Castings. I, II, III. Composition of Malleable Iron Mixtures. IV, V. Melting Plants and Their Operation. H. H. Shepherd. *Iron & Steel Industry,* Vol. 9, Nov. 1935, pages 51-35; Dec. 1935, pages 90-93; Jan. 1936, pages 127-131; Feb. 1936, pages 167-171; Mar. 1936, pages 204-208; Apr. 1936, pages 245-248. Brief review of the developments and improvements of physical properties of malleable Fe castings. There seems to be a narrowing of the gap which exists between the physical properties of good quality malleable Fe and the modern high strength cast irons. Many malleable plants produce material with a tensile of 55,000 lbs./in.^{2} and 15 to 25% elongation. Part II. It is a fairly generally accepted view that to secure malleable castings, it is advisable to limit the amount of annealed scrap in the mixture. In the case of malleable made from cupola melting and without subsequent treatment of the molten metal more than 3 to 4% of scrap causes reductions in the elongation and yield values. Steel scrap may be added to the mixture. For successful steel mixture practice, superheated metal without excessive oxidation is necessary. Part III. Refined pig Fe is rarely used for the manufacture of malleable by processes other than the cupola process. For whiteheart malleable the Mn should never be less than the S and where maximum ductility combined with normal strength is required the Mn should be from 1.5-2 times the S. For blackheart malleable made in a cupola a Mn content of 2.5 times that of the S is recommended. The influence of Ti, Cr and V are also briefly discussed. Part IV. The history and developments of the methods of melting suitable Fe mixtures for the production of malleable castings embraces almost the entire history and development of the melting of metals. Practically all types of melting practice have been, and still are used in varying degrees of output, from the crucible to electric and rotary furnaces. Comments are made on the crucible, cupola and duplex methods of melting. Part V. Further comments are made on the triplex process, and hand fired, pulverized coal fired and oil fired air furnaces. The use of the open-hearth furnace is discussed. Electric melting is considered and efforts to equalize the overall costs of electric melting with those of other melting mediums have largely consisted of utilizing the advantage of being able to use cheaper materials to make up the charge. CEJ (3b)

Studies on Solidification and Contraction in Steel Castings—III—The Rate of Skin Formation. C. W. Briggs & R. A. Gezelius. *Transactions American Foundrymen's Association,* Vol. 7, Feb. 1936, pages 274-295. The factors that influence the velocity of solidification of a steel casting, and the rate at which the skin forms are discussed. Studies are made on shapes of varying volumes and also on shapes with varying surface area and a constant volume. The numerical values obtained were used to calculate constants and formulas of solidification and to evaluate the importance of the theoretical considerations. A summary of the points as brought forward in the paper is: (1) The rate of skin formation increases as the volume of the steel casting decreases. (2) The greater the surface area of a steel casting the faster is the rate of skin formation. (3) The velocity of solidification is a constant; i.e., at any definite time after pouring the volume of steel solidified/in.^{2} of mold surface is the same. (4) Variations in the ordinary used molding materials results in a little more than a perceptible change in the velocity of solidification. (5) The degree of superheat modifies the rates at which the skin forms. (6) Calculations of the rate of skin formation can be made and predicated in various sizes of sphere castings. CMS (3b)

Mechanically Strong Cast Iron (La Fonte résistante) Guy Hénon. *Revue de Fonderie Moderne,* Vol. 30, Feb. 25, 1936, pages 57-67. Properties and manufacture of cast Fe of high mechanical strength, 25 kg./mm.^{2} minimum shear strength and 550 kg./mm.^{2} minimum bending strength, of pearlitic cast Fe with an elastic modulus of 16,000 kg./mm.^{2}, of cast irons taking good polish, elimination of porosities, and of heat and wear resistant cast Fe are discussed and the effect of the content of Si, C, Mn, S, P on these properties described. The composition should be in general: C between 3-4% depending on the operating conditions of the cupola; the lower values are preferable; Mn 0.7—0.9%, S less than 0.10% or even 0.08%, P usually less than 0.3%, for pieces of easy pouring qualities, however, up to 0.6%; Si should be regulated by the thickness of the piece as follows: 6-10 mm., 1.80% S; 10-15 mm., 1.65%; 15-25 mm., 1.50%; 25-35 mm., 1.35%; 35-45 mm., 1.20%. The charge should contain not more than 30% of cast Fe scrap of coarse graphitic grains, and the direct use of steel scrap should be avoided. White cast Fe may be usefully employed as it has a low Si content. Elements of unknown quantity and nature especially those tending to graphitize should not be used. A few examples of balanced charges are given. Ha (3b)

A Summary of Information on the Preparation and Properties of Pure Iron. John G. Thompson & Harold E. Cleaves. *Bureau of Standards Journal of Research,* Vol. 16, Feb. 1936, pages 105-130. A critical review of available information leads to the conclusion that really pure Fe (Fe free from significant amounts of all impurities) never has been prepared. Consequently many of the fundamental properties of Fe cannot be defined with the accuracy desirable for such an important metal. Available information on the preparation and properties of the purest available forms of Fe is summarized in the paper. WAT (3b)

American Open-Hearth Practice (Erfahrungen in amerikanischen Siemens-Martin-Werken) C. Schwarz. *Stahl und Eisen,* Vol. 56, Jan. 16, 1936, pages 68-72. A summary of the 18th Open-Hearth conference of the A.I.M.M.E., Apr. 1935. SE (3b)

Rustless Steel Castings (Les pieces moulées en aciers inoxydables) Jacques Lemoine. *Métaux,* Vol. 10, Dec. 1935, pages 305-310. Principal rustless steels used as castings are: (a) Martensitic—12-15% Cr with 0.38, 0.30 and below 0.15% C; (b) ferritic with 16-30% Cr; (c) Ni-Cr 18:8; austenitic Ni-Cr with 20-25% Cr and 10-15% Ni. All high Cr steels offer some difficulties on casting and machining. GTM (3b)

Gaseous and Solid Impurities in Ingots. J. H. Andrew. *Iron & Steel Industry,* Vol. 9, Jan. 1936, pages 149-151. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 54L/8. CEJ (3b)

Defects in Iron Castings: their Cause and Cure. T. Tyrie. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 515-554. See *Metals & Alloys,* Vol. 6, June 1935, page MA 224. CEJ (3b)

Study of a New Type of Ingot. P. V. Umrikhin & E. I. Sukhova. *Metallurg,* Vol. 11, June 1936, pages 10-18. In Russian. An ingot mold of a design taken from American sources was investigated for casting quality steels. Segregations and pipe were greatly reduced, segregation being a function of gas content of the metal. Warming hot tops with thermite increased quality of steel reducing top croppage to 17%. (3b)

Recent Developments in British Synthetic Molding Sand Practice. J. J. Sheehan. *Proceedings Institute of British Foundrymen,* Vol. 27, 1933-1934, pages 199-240. See *Metals & Alloys,* Vol. 6, Apr. 1935, page MA 141. CEJ (3b)

Developments in the Production of Malleable Castings, Part VI. Melting Plants and their Operations. H. H. Shepherd. *Iron & Steel Industry,* Vol. 9, June 1936, pages 375-380. The application to malleable Fe melting of 3 particular types of rotary furnaces, namely, the Brackelsberg, Sesci, and Stein and their design, construction and operation are discussed. A duplex system involving melting in the cupola, desulphurizing, and then superheating in a rotary furnace provides the most efficient, cheapest, and satisfactory way of making modern high class malleable castings. CEJ (3b)

Residual Metals in Open-Hearth Steel. Arsenic, Antimony and Others. John D. Sullivan & Ray A. Witschey. *Metals & Alloys,* Vol. 7, July 1936, pages 171-173. Statistical information on occurrence of elements residual in plain open hearth steel from ore, pig Fe or scrap of charges. Analytical methods for As and Sb in steel are given. WLC (3b)

Some Notes on Ingot Molds. T. Swinden. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 192-221. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 441. CEJ (3b)

The Technique of Chilling. J. Roxburgh. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 586-603. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 393. CEJ (3b)

Alloys in the Iron Foundry. J. Roxburgh. *Proceedings Institute of British Foundrymen,* Vol. 27, 1933-1934, pages 396-413. See *Metals & Alloys,* Vol. 6, Mar. 1935, page MA 95. CEJ (3b)

Experiences in the Manufacture of High Grade and High Duty Alloy Iron Castings. P. A. Russell. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 482-504. See *Metals & Alloys,* Vol. 6, May 1935, page MA 181. CEJ (3b)

Molding of a Special Manifold (Moulage d'un Collecteur d'Echappement special) J. Nichols. *Revue de Fonderie Moderne,* Vol. 30, Mar. 10, 1936, page 79. Describes method for molding a piece with more branches than the pattern has. Ha (3b)

* * *

Contribution to the Study of Graphite Formation and Structure in Cast Iron and its Influence upon the Properties of the Cast Metal. Heinrich Nipper. *Proceedings Institute of British Foundrymen,* Vol. 27, 1933-1934, pages 127-156. See *Metals & Alloys,* Vol. 6, Mar. 1934, page MA 94. CEJ (3b)

Open-Hearth Slags. T. Blundell. *Iron & Steel Industry,* Vol. 9, Feb. 1936, pages 174-175. Remarks are confined to acid and basic slags in the open-hearth furnace. Discussion is from the point of view of the steel melter and the works metallurgist. CEJ (3b)

Steel Castings with Special Reference to Alloy Steels. W. H. Hatfield. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 122-149. See *Metals & Alloys,* Vol. 6, Mar. 1935, page MA 95. CEJ (3b)

Steel Melting Slags. The Chemical Aspect. W. R. Maddocks. *Iron & Steel Industry,* Vol. 9, Mar. 1936, pages 213-214; *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, page 347. Control of the refining process in all open hearth furnaces is effected by means of the slag. Basic electric arc furnace conditions give a slag that is absolutely reducing in character and free from Fe oxide. Acid slags can be controlled so that their oxidizing power is feeble. Basic slags are more difficult to control towards the end of the process because of the increase in oxide content. CEJ + MS (3b)

Cupola Practice with a View to Closer Carbon Control. W. H. Bamford. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 555-580. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 440. CEJ (3b)

Open-Hearth Operators Review Progress in Furnace Construction and Maintenance. *Steel,* Vol. 98, Apr. 27, 1936, pages 76, 79-80, 82. Report of 19th conference of the Open-Hearth Committee, American Institute of Mining & Metallurgical Engineers. Among subjects discussed were melting steel in shallow baths; open-hearth furnace design; combined furnace and air burner port; design of checkerwork; Cu molds and stools; mold maintenance; cinder pots; refractories and insulation; temperature measurement; nozzle performance; use of carbometer; and residual metals in open-hearth steel. MS (3b)

The Effect of Deoxidation on the Rate of Formation of Ferrite in Commercial Steels. D. L. McBride, C. H. Herty, Jr. & R. F. Mehl. *Transactions American Society for Metals,* Vol. 24, June 1936, pages 281-312. Rates of precipitation of ferrite from austenite at constant temperature between A_3 and A_1 for different degrees of undercool are reported for Si- and Al-killed steels, C 0.33-0.50%. Method of deoxidation has only incidental effect upon rate of formation of ferrite aside from its influence on grain-size. Fine grained austenite (Al-killed) precipitates ferrite faster than coarse grained (Si-killed). Based on equal grain-size ferrite formation proceeds at the same rates with both types of deoxidation. Log of the rate constant is a linear function of degree of undercool. Si-killed steels show greater dependence upon degree of undercool than Al-killed. At low degrees of undercool the rate of ferrite formation is faster in Al- than in Si-killed steel while with greater degree of undercool this relation is reversed. Rate of ferrite nucleation determines rate of precipitation rather than the rate of C diffusion. Ratio of ferrite formed by normalizing to that formed by annealing and difference between 2 classes of deoxidation are explained on the basis of the grain-size effects of the deoxidation methods. WLC (3b)

Cast Iron and the Electric Furnace (La Fonte et le Four Electrique) Auguste Le Thomas. *La Fonte,* No. 20, Mar.-Apr. 1936, pages 757-765. See *Metals & Alloys,* Vol. 7, July 1936, page MA 343L/9. WHS (3b)

Pig Iron is made in Smaller Size. G. A. T. Long & W. M. Ramsey. *Foundry,* Vol. 64, Feb. 1936, pages 44, 46. See *Metals & Alloys,* Vol. 7, July 1936, page MA 343L/9. VSP (3b)

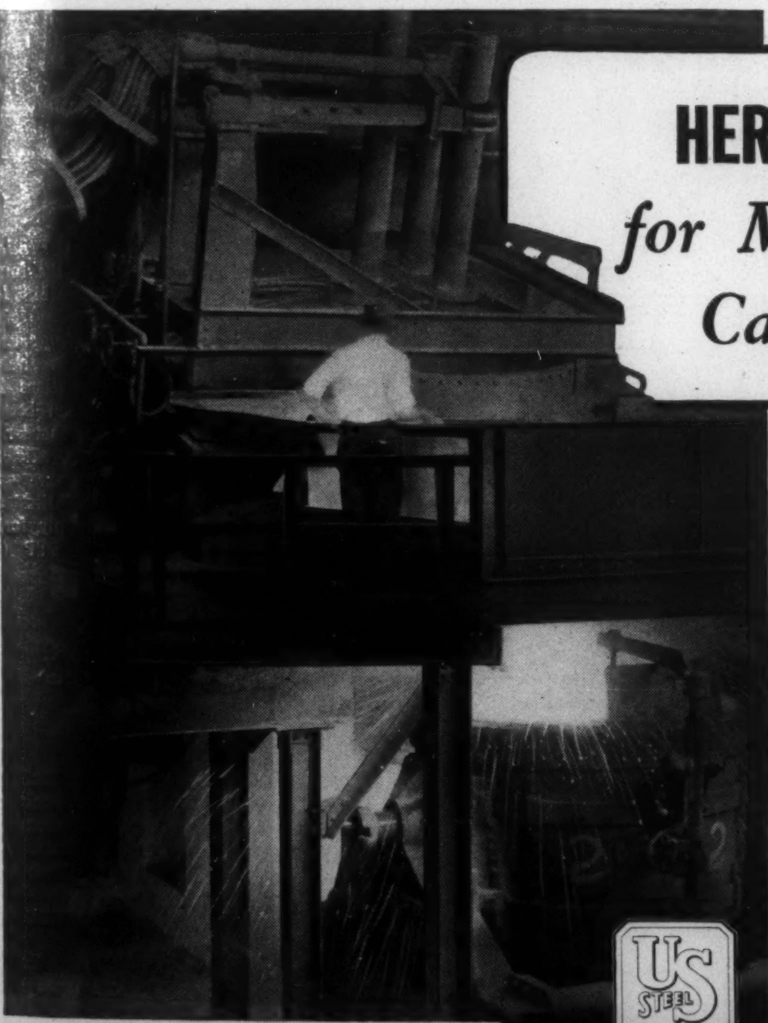
Further Notes on Defects in Steel Castings. C. H. Kain. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 661-676. See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 318. CEJ (3b)

Rimming Steels. A. Jackson. *Iron & Steel Industry,* Vol. 9, Feb. 1936, pages 179-182. Paper read before the Newport & District Metallurgical Society on Jan. 11, 1936. An ingot of rimming steel is characterised by its thick, pure, outer skin or rim and its impure center. The rim may or may not enclose pencil shaped blow-holes. For many purposes a possible improvement would be the production of a compound ingot, having a pure rimmed skin, with a killed steel core, to which killing agent has been added when the skin has attained requisite thickness. The results of a series of experiments on the effect of various treatments on the rim are presented. CMS (3b)

From Liquid to Solid. W. Machin. *Iron & Steel Industry,* Vol. 9, Oct. 1935, pages 6-7. A general discussion of the problems in connection with contraction which occur during the manufacture of any casting. Practical points such as core construction and backing material are considered. CMS (3b)

The Balanced Blast Cupola. W. Y. Buchanan. *Foundry Trade Journal,* Vol. 54, Jan. 16, 1936, pages 69-73. Paper read before the Scottish Branch of the Institute of British Foundrymen. The balanced-blast type of cupola is designed by Fletcher and is covered by patents, and the principles have been explained at length in numerous papers by users as well as by the British Cast Iron Research Association in their published literature. The present paper deals with the actual cases of conversion of cupolas with a view to their improvement in quality of output and economy. Several cases are considered. Following the conversion of 32″ bore cupola to the balanced blast system, the 54″ cupola was fitted with a set of tuyeres of dimensions calculated from the proportions of 32″ bore cupola. The improvement in coke consumption was again obtained under the same conditions, and a larger proportion of very heavy cast Fe scrap could be used in the furnace charges. In working this furnace the coke charge was reduced throughout the progress of the blow from 4 cwts. to 3½ cwts., and sometimes to 1 cwt. in the final charges, the Fe charges being maintained constant throughout. Comparison of types of coke, continuous running, effect of continuous spout on total C, the chill test, lime washing cupola coke, etc. are also discussed. AIK (3b)

The Electric Furnace in the Foundry (Le Four électrique en Fonderie) P. Bunet. *Usine,* Vol. 45, Apr. 30, 1936, pages 29-31. The different types and their special fields of application are reviewed. Ha (3b)



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US STEEL

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UNITED STATES STEEL

The Control of Cupola Operation. H. L. Campbell & John Grennan. *Transactions American Foundrymen's Association,* Vol. 7, Feb. 1935, pages 228-246; *Foundry Trade Journal,* Vol. 54, Feb. 6, 1936, pages 117, 118; Feb. 13, 1936, pages 141-142. See *Metals & Alloys,* Vol. 7. May 1936, page MA 230R/6. CEJ + AIK (3b)

Production of High Test Cast Iron (L'Élaboration des Fontes a Hautes Caractéristiques Mécaniques) Marcel Dudouet. *Bulletin de l'Association Technique de Fonderie,* Vol. 10, Feb. 1936, pages 40-48. Paper presented before the A. T. F., Mar. 7, 1936. Superheating the metal may produce either good or bad results. The addition of 95% ferrosilicon to the molten metal just before pouring produces normal graphitization without the danger of having graphite and ferrite rosettes. Oxidizing acid slags produce good structure and fluidity as well as reducing shrinkage. A cast Fe containing 2.85 to 3.00% C, 1.80% Si, 0.80% Mn, 0.09% S, and 0.25% P, may be used for castings of various sections by suitable additions of ferrosilicon or Si-Cr alloy. The effect of the P eutectic, as well as the graphite, is more dependent on form and distribution than on the quantity present. Pieces in the charge should not be under a fixed size. Electric furnace, cupola, and duplexed metals are discussed. WHS (3b)

The Production of Iron Castings. H. Field. *Journal Institution of Production Engineers,* Vol. 15, May 1936, pages 224-255. Includes discussion. A general account of the foundry methods used and the problems encountered in the production of high-grade Fe castings. JCC (3b)

Roof Temperature Control for Use in Open Hearth Furnace. M. J. Bradley. *Iron & Steel Engineer,* Vol. 13, Feb. 1936, pages 24-30. Protection afforded by roof temperature control allows maximum safe operating temperature to be used continuously. Experience on furnaces with insulated roof shows 12% increase in production and 15% increase in roof life. WLC (3b)

Steel Melting Furnaces, Automatic Control in the Open Hearth. A. J. Boynton. *Iron & Steel Engineer,* Vol. 13, Jan. 1936, pages 25-26. Automatic equipment stabilizes conditions. With such facilities intelligent operators become familiar with conditions producing the highest quality product most economically. WLC (3b)

Finishing the Heat of Steel. XLII, XLIII, XLIV. J. H. Hruska. *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, pages 336-337, 355; May 1936, pages 422-423; June 1936, pages 514-515, 520-521. Tabulates composition, size, and melting processes used in fabrication of modern forging steels. Ingots weighing 70 tons and up are generally of inferior quality, as high segregation and large crystallization are natural consequences of heavy masses. Use of the best available raw materials and most efficient production methods will decrease the amount of these defects. Well deoxidized and degasified metal should be used. Higher Mn content seems to be beneficial. Best grades of wire are made from electric and crucible steel. Largest tonnages, however, are produced from smaller open-hearth furnaces. Quality practice is followed in producing ingots for this purpose. Suitable hot top, amounting up to 15% of ingot volume is used. Teemed ingots are cooled to below red heat to eliminate tearing or cracking in stripping.

Parts XLIII, XLIV. These instalments deal with manufacture of quality rimming steels. These are made in the basic open-hearth furnace or by duplexing in acid Bessemer and basic open-hearth furnaces. In open-hearth process, pig Fe additions are 30-38% for molten charges and 35-45% if cold. Initial Mn content should be 1.25% for heats with up to 40% pig Fe. Residual Mn content for top-poured ingots should not exceed 0.12% and for bottom-cast ingots, 0.15%. Teeming temperatures should be 50°-125° F. above m.p. of steel. Tapping temperatures above 3000° F. should be avoided. Pouring rate depends upon rimming properties of metal, determined by visual observation. Slight decrease in rate is advisable in latter stages. To prevent rise in central portion of ingot, cast Fe plates or "caps" are placed on top of ingots. This is sometimes supplemented by H_2O cooling. Addition of deoxidizers should be avoided, but, if necessary for proper rimming, Al in shot form is usually added in mold. If ingot settles 3″-4″, addition of ½ oz. Al per ton of steel will correct this. Rise of 3″-4″ can be corrected by slower pouring. To avoid introduction of Al_2O_3 in steel, some makers add 2-4 lbs. of ferro-carbon-titanium/ton in the ladle, and hold 5-8 min. MS (3b)

Steel Castings. C. K. Everitt. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page IX. Lists types of C and alloy cast-steels and their principal uses and outlines important features of steel foundry practice. MS (3b)

Dry Sand Cover Core Cuts Molding Cost. J. H. Eastham. *Foundry,* Vol. 64, Apr. 1936, pages 49, 110. Describes method of making dry sand cover core. Conditions under which such a method may be used are outlined. VSP (3b)

Simplifying the Complicated Mold to Cut Production Costs. J. H. Eastham. *Iron Age,* Vol. 137, Mar. 26, 1936, pages 40-42. Describes method devised for the production of a difficult casting, a tire machine table. VSP (3b)

Degree of Oxidation of Open Hearth Slags and their changes During the Process (Du degré d'oxidation des scories Martin et de leur évolution au cours de l'opération) Gabriel Husson. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 237-242. Richarme (*Bulletin de l'Industrie minerale,* 4th series, Vol. 5, 1906, page 83) developed a formula defining the dephosphorizing properties of slags as a function of their basicity. In the present paper an attempt is made to determine the oxidizing power of slags from their content of free FeO. Ternary diagram of the FeO-SiO_2-CaO system is used as the basis for discussion. No experimental results are given. JDG (3b)

Study of Rail Steel Ingots (Contribution à l'étude du lingot d'acier pour rails) G. Grenier. *Revue de Métallurgie,* Vol. 33, May 1936, pages 318-324. Slower teeming at moderate temperatures reduces primary segregations in ingots, particularly when they are shaken even mildly as in transporting over rails while still liquid. The effect is clearly visible on cross sections of rails rolled from them. JDG (3b)

Pours Six 130-Ton Steel Castings. William G. Gude. *Foundry,* Vol. 64, May 1936, page 47. Describes the casting of 6 large castings by the Hubbard Steel Foundry, division of Continental Roll & Steel Foundry Co. Composition of metal was: C 0.22-0.27%; Mn 0.65-0.85%; Si 0.30-0.45%; S 0.045%; and P 0.03%. Total metal used was 289,000 lb. VSP (3b)

4. WORKING

The Plastic Working of Metals. Georg Sachs. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 51-54. Author briefly reviews the most important theoretical knowledge that has been obtained in recent years which deals with the plastic working of metal. He discusses (1) properties of material and (2) technological mechanics. Under (1) are considered (a) new methods developed for accurately determining strain hardening, (b) influence of speed for both hot and cold working and (c) effect of crystal orientation. Under (2) are included as important factors (a) properties of the material, (b) design of tools, and (c) friction. Some ingenious methods are cited which have been used in the determination of actual deformation and some processes are listed that have been improved by such studies. 5 references. HBG (4)

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Roll Design for Shapes (Ueber das Kalibrieren von Formstahl) C. Holzweiler & T. Dahl. *Stahl und Eisen,* Vol. 56, Jan. 16, 1936, pages 57-68. Roll design for various H and I beams is discussed. SE (4a)

Tests of Hot Saws and Hot Saw Blades (Versuche an Warmsägen und Warmsägeblattern) K. Häusler. *Stahl und Eisen,* Vol. 56, Apr. 23, 1936, pages 490-492. Factors influencing hot saw cutting are discussed, such as temperature and shape of work, strength of blade, number and shape of teeth, feed, speed of cut, method of cooling, mounting of saw, and sharpening. Suggestions for improvements are made and methods of testing saw blades considered. SE (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Forging and Stamping of Stainless Steels (Forgeage et estampage des aciers inoxydables) J. Chambeyron. *Métaux,* Vol. 10, Dec. 1935, pages 291-293. Steels with 6% Cr are relatively easy to forge at 850°-1225° C. and air cooled. Steels with 13-18% Cr do not offer particular difficulties to forging at 1150°-1225° C. These steels can be readily stamped. Austenitic steels are the most difficult to forge. On solidifying, an ingot of austenitic steel forms large columnar crystals which may develop into parallel cracks on forging. These steels have a lower thermal conductivity than the ordinary steels. Before forging the ingots are heated slowly up to 850° C. then faster to 1150°-1200° C. according to type of steel. Forging temperature for 18:8 is 1200°-875° C.; for 18:8 with Mo 1200°-1000° C. Increase in Ni content lowers the initial forging temperature to 1100° and ends at 900° C. Valve steels containing 10% Cr, 3.5% Si and with or without Mo are forged at 1200°-850° C. At 1275°-1300° C. these steels are brittle and crack on forging. After forging the steel is placed in a furnace at 850° C. for a few minutes until the equilibrium temperature is established, then the steel is cooled in a pit. GTM (4b)

Manufacture of Heavy Forgings. A. B. Winder. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XII. Summarizes progress in the forging and stamping industries. MS (4b)

Reducing Forging Costs with Compressed Air. C. H. Vivian. *Compressed Air Magazine,* Vol. 41, Mar. 1936, pages 4967-4972. Description is given of the general design and operation of forging hammers. Recent installations have replaced steam with compressed air for forge-shop power. Air operation becomes increasingly more economical than steam as the standby time of the hammer increases. Advantages claimed for air operation are: greater operating efficiency, greater flexibility, reduction of idling, reduction of repair and maintenance costs, decrease in amount of lubricant, and increased comfort and cleanliness. Illustrated description is included of several air compressors currently used to supply forging power. FPP (4b)

4c. Cold Working, including Shearing, Punching, Drawing & Stamping

Stamping of 18:8 Steels (Emboutissage des aciers inoxydables type 18:8) M. Lecat. *Métaux,* Vol. 10, Dec. 1935, pages 297-298. The 18:8 steels with given ductility and malleability offer no difficulty in stamping. Speed of stamping of 18:8 should be much slower than for soft C steels (about 6-8 mm./min.). After final stamping the steel should be quenched in water from 1100° C. Each treatment should be followed by cleaning in $HCl + HNO_3$ solution or $H_2SO_4 + HCl$ or in $HNO_3 + HF$ mixture. GTM (4c)

Safe Capacities for Presses and Their Relation to Shearing Strengths of Material. C. W. Hinman. *Modern Machine Shop,* Vol. 8, May 1936, pages 62-64. Tables showing the forces to be exerted in punching and shearing operations and ultimate shearing strengths for a number of metals, leathers and papers in tons for a cross section of 1 in.^{2} are given. Ha (4c)

Cold Finished Bars, Flats, Shafting, Shapes. H. W. Graham. *Metal Progress,* Vol. 29, Apr. 1936, pages 47-51. Describes cold finishing processes for steel and gives data on resultant improvement of properties. WLC (4c)

Wire Mill Drafting Tables. TOM GORE, JR. *Wire & Wire Products,* Vol. 11, May 1936, pages 221-224. The tables give the data for different percentages of partial reduction practicable for a given final reduction. Ha (4c)

The Production and Treatment of Copper Alloy Wire. *Canadian Chemistry & Metallurgy,* Vol. 20, June 1936, pages 200, 202. An historical sketch covering preparation for drawing, modern drawing machines, annealing brass wire, heat treatment of Cu alloys, pickling, and colors on Cu alloy wire. Several formulas for the latter are given. WHB (4c)

Wire-Drawing. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XI. Brief discussion of drawing of wire and bars, wire-rope making, and strip rolling, with particular reference to Sheffield, England. MS (4c)

Some Practical Notes on Working and Jointing Sheet Aluminium in Motor Vehicle Construction. A. J. T. EYLES. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, pages 324-326. Notes on the working and polishing of sheet Al for the production of automobile and motor coach panelling. JCC (4c)

The Deep Drawing of Sheet Steel, Specification and Research Problems. L. B. HUNT. *Iron & Steel Industry,* Vol. 9, Nov. 1935, pages 54-56. The temper rolling of sheets to meet the requirements of individual pressings has so far frustrated all efforts at specification by the user and has led to the development of the system whereby the supplier accepts all scrap in excess of 3 or 5% of a particular batch of pressings, and provides a contact man whose duty it is to watch the performance of his company's sheets in the press and to enable immediate adjustment of discrepancies. Sheets are far more susceptible to slight modifications in temper rolling than is disclosed by mechanical testing. To be a commercial proposition specification must first be directed towards the production cycle including rolling, pickling, normalizing and/or annealing and temper rolling. CMS (4c)

■ 4d. Machining ■

H. W. GRAHAM, SECTION EDITOR

Developments of Centerless Grinding (Les Progrès de la Rectification "Centerless"). PIERRE DEVAUX. *La Revue Industrielle,* Vol. 66, May 1936, pages 184-186. Principles of the method are discussed. Defects to be avoided are reviewed. Last section gives advantages of the method which are: speed of production, possibility of employing unskilled labor, suitability of the method for long flexible bars. FR (4d)

The Influence of Cutting Fluids on Tool Life in Turning Steel. O. W. BOSTON, W. W. GILBERT & C. E. KRAUS. *Transactions American Society Mechanical Engineers,* Vol. 58, July 1936, pages 371-378. Cutting-speed tool-life conforms to the formula $VT^n = C$, where V is the cutting speed in ft./min., T is the tool life undercut up to the time of tool breakdown in min., and n, the exponent of T, is the tangent of the angle of slope of curve plotted on double logarithmic paper; the constant C depends on shape, material, size of cut and cutting fluid. Each cutting fluid exerts a characteristic influence. In all tests, the same exponent in T is obtained when cutting dry and with aqueous solutions and emulsions, with definite constants. Addition of colloidal graphite suspended in water to an emulsion gives slightly more favorable tool life but inferior finish; when colloidal graphite of not less than 0.153% by weight is added to the emulsion the cutting speed is increased about 10% for a given tool life, and the tool life for a given cutting speed about 100%. The order of cutting fluids from lowest to highest speeds which give a tool life of 2 hrs. is:

Cutting Fluid	Speed, ft./min.
Dry cutting	83
Plain mineral oil	89
1 part oil to 16 parts water	93
Sulphurized mineral and sulphochlorinated mineral	97
1-16 emulsion containing 0.153% by wt. colloidal graphite	100
Mineral oil containing 0.153% by wt. colloidal graphite	106

Ha (4d)

Machine Tools for Machining Metals (Les Machines-Outils pour le Travail des Métaux). *La Technique Moderne,* Vol. 28, May 15, 1936, pages 347-358; July 1, 1936, pages 459-466. Describes machine tools seen in recent shows at London, Milan, Cleveland and particularly Leipzig. FR (4d)

Producing Bolts from Mild Steel Bars. *Railway Gazette,* Vol. 64, June 12, 1936, page 1125. Installation of Ward single pulley headstock capstan lathes at Crewe Works of the L. M. S. R. is briefly described. FPP (4d)

Screw Machine Practice for New Free Cutting Aluminum Alloys. J. F. CONEEN. *Iron Age,* Vol. 137, Mar. 5, 1936, pages 33-35. From a paper read before the eastern division of the Screw Machine Products Association at New York. Al and its alloys differ in their machining properties, and therefore changes in machining and tool practice are necessary. A new screw machine alloy known as 11S has been developed especially for fabrication of parts on automatic screw machine, and machinability comparable to brass. Gives details of machining 11S alloys and describes various tools used. Includes a table giving speeds and feeds used in machining 11S Al screw machine stock. VSP (4d)

Stresses due to Machining (Ueber Bearbeitungsspannungen). W. RUTTMANN. *Technische Mitteilungen Krupp,* Vol. 4, June 1936, pages 89-97. Present knowledge of stresses originated in materials by machining operations is reviewed. Samples of equal heat treatment can show both tensile and compressive stresses according to the kind of mechanical treatment to which it was subjected. In general, when slowly machined with good cooling, compressive stresses are originated in the marginal zone while when machining quickly and without cooling, and in grinding, tensile stresses show up. The results are critically discussed and practical applications in the mechanical treatment of metals and their correct shaping are attempted. 42 references. Ha (4d)

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5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Treatment of Steel for Clock and Gramophone Mainsprings. F. L. TINGLE. *Iron & Steel Industry,* Vol. 9, Dec. 1935, pages 121-124. The material used may be either straight C steel, Si-Mn, or Cr-V, produced either in the open-hearth or electric furnaces; the precise material which is used being determined by the requirements which have to be met and the price the customer is prepared to pay for the product. Attention is restricted to plain C steels; typical composition 1.05% C; 0.42% Mn; 0.25% Si; 0.02% P; 0.015% S. Billets from which the strip is produced are hot rolled to strip finishing at about 14 to 16 gage thickness. Further reduction in thickness then takes place by cold rolling, with intermediate annealings. For correct hardening quenching is done from 760° to 780° C. at the Ac point. CMS (5)

Axle Shafts Are Given Unusual Heat Treatment. A. H. ALLEN. *Steel,* Vol. 98, Apr. 6, 1936, pages 32-35. Describes practice of the White Motor Co., Cleveland, O. Steel for rear axle shafts contains 0.55-0.85% Cr, 1.60-2.10% Ni, 0.15-0.25% Mo, and 0.40-0.50% C, with preference on the upper end of this range. Shaft is machined before heat treatment. Hardness before heat treatment is 220-250 Brinell. Scale preventing coating of kaolin and Na_2SiO_3 is applied to splines. Shafts are heated in an oil-fired furnace, with a slightly reducing to neutral atmosphere, to 1500° F., and held at that temperature for 15-20 min. Charge and furnace are brought down to 1270° F., for smallest size shaft, in 2½-3 hr., and shafts are transferred as speedily as possible to an oil quenching bath at 140°-160° F. and left there for 2-2½ min. They are placed immediately in an oil-fired bath of $NaNO_3$ at 900°-1000° F. and are drawn there for 2 hrs. They are then quenched in hot H_2O. Brinell hardness after heat treatment is 368-388. To facilitate drilling bolt holes in flange, outer rim is drawn back by rolling flange several times in a Pb bath heated to 1400° F. Shafts have a minimum elastic limit of 160,000 lbs./in.², ultimate strength of 180,000 lbs./in.², elongation of 15% in 2 in., and reduction of area of 50%. MS (5)

Heat Treatment of Driving Gear Parts. I. E. LOBANOV. *Liteinoe Delo,* Vol. 7, No. 4, 1936, pages 5-11. In Russian. Inferior physical properties of parts in question led to investigation of their heat treatment. The cause of troubles was connected with alumina stringers. (5)

■ 5a. Annealing ■

Physical Changes in Hardening and Annealing of Steel (Tillstandändringen vid härdning och anlöpning av stal) GUNNAR HÄGG & EINAR OEHMAN. *Jernkontorets Annaler,* Vol. 120, Apr. 1936, pages 143-166. Discussion of von Vegesack's results (*Jernkontorets Annaler,* Vol. 120, Feb. 1936, page 49) and reply. HCD (5a)

Heat Treating Steel Wire Rods in Coils for Bolt Stock. J. H. BROWN. *Industrial Gas,* Vol. 14, June 1936, pages 13, 16-17. A gas-fired bell-type furnace is used for annealing; operating data are given. Ha (5a)

Annealing for Quality. LEE WILSON. *Industrial Heating,* Vol. 3, Aug. 1936, pages 523-525. Vertically arranged Cr-Ni tubes through which the fuel passes to the bottom end where it is burned, are claimed to give a more uniform and economical annealing process. Ha (5a)

Study of Soaking Time Used in Thermal Treatment of Aluminum Alloys. I. I. TUTOV. *Metallurg,* Vol. 11, June 1936, pages 83-90. In Russian. Al alloys containing 4.12% Cu, 1.53 Mg, 1.68 Ni and duralumin were investigated. The only result of a long soaking time is grain growth in metals. The usual soaking time, 2.5-4 hours should be reduced to 25-30 minutes. (5a)

Annealing Steel in Controlled Atmosphere. I. T. BARUZDIN. *Metallurg,* Vol. 11, June 1936, pages 66-76. In Russian. Steels with different C content were annealed in dissociated NH_3. The surface of metal was usually slightly oxidized producing grayish coloration. Under 650° C. no decarburization was observed during 3 hours, maximum time of treatment. With higher temperatures decarburization increased in proportion to C content. (5a)

■ 5b. Hardening, Quenching & Drawing ■

Automobile Frame Steel and its Heat Treatment. G. N. FOMIN & S. A. BERNER. *Kachestvennaia Stal,* Vol. 4, No. 1, 1936, pages 39-43. In Russian. Steel used has the composition: 0.24-0.34% C, 1.25-1.50 Mn, 0.25 Si. Some troubles with inferior physical properties led to investigation of the temperatures involved, so that instead of using one quenching temperature for all steels they were subdivided in classes varying about 0.02% in C and about 0.05% in Mn for which intermediate temperatures were used. Many data are given. (5b)

Silicomanganese Spring Steel and Its Heat Treatment. G. N. FOMIN & S. A. BERNER. *Kachestvennaia Stal,* Vol. 4, No. 1, 1936, pages 34-39. In Russian. Investigation was conducted to determine the influence of variation in composition from a standard on physical properties of the metal. Standard analysis was: 0.50-0.60% C, 0.45-0.80 Mn, 0.35 S, 0.45 P, 1.3-1.8 Si. Complete data on physical testing are furnished. All physical requirements are met when C content is higher than 0.60%; under 0.50% the results are unsatisfactory. With Si at the lower limit of 1.30% and Mn below it, 0.35%, steel is on the margin of desired physical qualities. When Si was increased above its upper limit, 2.05%, up to 2.2% physical properties were fully met, but the material was a bit hard in the as furnished state which interfered with its cutting. 900-920° C. can be recommended as quenching temperature in production. (5b)

Application of Electric Furnace to the Heat Treatment of Springs (L'Application du Four Electrique au Traitement Thermique des Ressorts) JEAN GODDOT. *Science et Industrie (Electricité),* Vol. 20, Feb. 1936, pages 48-50. As indicated by endurance studies of steels, external layers of springs must be correctly treated and not impaired by the treatment. Furnaces using other fuels are not so easy to control as electric furnaces. The latter show following advantages: regularity, control of atmosphere, automatic control of temperature and ease to distribute heat as needed in different parts of the furnace, ease of insulation, good thermal efficiency. The use of electric furnaces does not solve the problems encountered in spring treating if they are not correctly controlled. FR (5b)

Shorter Hardening Process. *Engineer,* Vol. 61, Apr. 24, 1936, pages 447-448. Discusses results obtained on the "Shorterizing" of C and alloy steels for the purpose of hardening them. The depth affected by the Shorter treatment was 0.11" to 0.13", and of this 60 to 89%, depending on class of steel, was martensitic. Best results from "Shorterizing" are obtained from use of forged or cast steel; there is nevertheless a wide field of application with pearlitic cast Fe. A new development for the Shorter process is the Shorter-double-duro process designed for hardening pins and journals of crankshafts and similar cylindrical parts where wear is excessive. Tabulates results of tests. VSP (5b)

■ 5e. Carburizing ■

Modern Gears. E. F. DAVIS. *Steel,* Vol. 98, Apr. 27, 1936, page 67. Abstract of paper before tri-chapter meeting of the Cincinnati, Columbus, and Dayton chapters, American Society for Metals, Apr. 21, 1936. Deals principally with forged steel gears for automobile transmissions. Rack-type cutting is favored. Gears are cut to close limits, hardened, then teeth are lapped to finished dimensions. Cyanide process is used for hardening to preserve surface finish and to produce hard surfaces to prevent wear. Cyaniding does not produce noisy gears; distortion is not caused by rapid heating; carburized gears are not noisier than oil-hardened gears; and gears are not noisy because they distort in fire. Distortion can be traced to quenching and not heating. Accurate cutting is necessary for quietness. Close control of cutting and heat treating is required for best results. Pitting of gear teeth causes early failure. Inclusions in steel cause trouble in cutting, increase cutter expense, and are a source of failure. Overstressing of metal during cold shearing may result in cracking of gears. Overburnishing causes surface to separate and pit, leading to fatigue failure. States in discussion that cyanide method can be used advantageously for all gears if they are not too large and C content is not over 0.45%. Maximum hardness which can be cut on rack-type cutter is 228 Brinell. MS (5e)

Determination of the Depth of Cementation and Speed of Carbon Diffusion in Steel. S. S. KANFOR. *Metallurg,* Vol. 11, June 1936, pages 55-65. In Russian. Parabolic formula $x^2 = Kt$ expressing diffusion during cementation is based on the assumption of a straight line relation between the amount of C absorbed and the difference in concentration. It is derived with a further assumption that the relation between the depth of penetration and amount of C absorbed is also a straight line function. The latter seems to be valid for thin coating, but for heavier carburized layers difference in concentration is not related to the depth of case. This was checked by literature data available and some experiments by the author. Speed of penetration in specimens isolated from outside influences was determined by carburizing steel bars for 40, 80 and 100 hours at 950° C., checking the depth of case on extra samples and heating the specimens for additional 100 hours. Before subjecting them to the latter operation they were thoroughly cleaned from carbonaceous deposits on their surface and coated with a gas tight compound. The increase in depth was the same indicating the constancy of C diffusion at a given temperature and independence of the difference in concentration, which was continuously decreasing. Linear speed of C migration in steel during cementation is expressed by the equation $v = v_k + v_x$ where v_k is the speed of C migration depending only on temperature and type of steel, provided steel is isolated from any outside influences. v_x is specified by the action of cementing medium becoming therefore a function of the distance from it. After a proper mathematical treatment of this expression the total depth of cementation can be expressed as $x = \frac{t}{k} + \sqrt[n+1]{\frac{t}{c}}$ where coefficients n, k and c can be determined experimentally. Application of this formula to published data showed its correctness. (5e)

■ 5f. Nitriding ■

Selective Nitriding. FEDERICO GIOLITTI. *Metal Progress,* Vol. 30, July 1936, pages 62-63. Articles to be treated are varnished where they are to be nitrided and then coated with Sn electrolytically. The varnish is then removed and parts subjected to nitriding. WLC (5f)

Chapmanizing. An Improved Case Hardening Process. *American Gas Journal,* Vol. 144, May 1936, pages 23-24. Steel is heated in the presence of an active N gas. A liquid bath is used for heating and also to carry the active N direct to the steel under treatment. N is furnished from NH_3" gas in cylinders; the active N is formed by an electrical reaction of the NH_3" in the "chapmanizer." Physical characteristics and properties of the treated steels are given. CBJ (5f)

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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

The Balanced Blast Cupola. L. W. Bolton. *Iron Age,* Vol. 137, May 21, 1936, pages 38-40, 93. Describes a new design furnace developed by J. E. Fletcher, known as a balanced blast cupola (British patent, 333,322 and United States patent, 1,853,120). 4 rows of tuyeres are used which deliver air from wind belt. In converting existing cupola to the new design, a new wind belt, large enough to accommodate the 3 rows of auxiliary tuyeres is usually required. Melting rate of these cupolas is between 12 and 15 tons/hr. Fuel consumption in new furnace is considerably lower than in a normally designed cupola. Highly superheated metal may be produced in the cupola. VSP (6)

Kinetics of Some Reactions of Interest to Ceramists—The Disintegration of Blast Furnace Linings Due to Carbon Deposition. C. C. Furnas. *Journal American Ceramic Society,* Vol. 19, June 1936, pages 177-186. Deposition of C from dissociation of CO is responsible for formation of large transverse cracks followed by crumbling and complete disintegration of the refractory. Experimental work is reported for several types of brick at various temperatures around 450° C. exposed to various % CO atmospheres. Fe_2O_3 is shown to induce the disintegration by favoring deposition of C while Fe_3O_4 does not aid in decomposition of CO. It is shown by results that the brick which are more completely fired to give desirable properties contain Fe as Fe_2O_3, which aids disintegration of the more completely fired brick. WB (6)

Equipment for Hardening Gears without Oxidation. J. B. Nealey. *Metal Progress,* Vol. 29, June 1936, pages 45-48. Describes furnace and quenching equipment and layout. WLC (6)

Kelsey-Hayes Melts Iron and Steel in Brackelsberg Units. Frank J. Oliver. *Iron Age,* Vol. 137, Apr. 9, 1936, pages 46-48. **Detroit Foundry Melts Metal in Rotary Furnaces.** Pat Dwyer. *Foundry,* Vol. 64, Apr. 1936, pages 46-48, 85, 89. Describes the furnace which is one of the largest installations in this country. The unit, in conjunction with an electric furnace, is used for melting gray Fe and alloy steel for brake drums and flanges, and composite drums and flanges by the Kelsey-Hayes Wheel Co. VSP (6)

Natural Gas for Cutting, Galvanizing and Soldering. F. Pexton. *Industrial Gas,* Vol. 14. June 1936, pages 9-10. Some instances are described in which savings were effected in manufacturing processes by substituting natural gas for acetylene in cutting, coke in galvanizing, and hydrogen in soldering. Ha (6)

Refractories. W. J. Rees. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XXVII. Discusses modern developments. MS (6)

Modern Furnace Applications of Refractories and Insulation. J. L. Spence & J. W. Craig. *Iron & Steel of Canada,* Vol. 19, Feb. 1936, pages 3-9; Apr. 1936, pages 5-7; June 1936, pages 12-16. Refractories available and their general characteristics, fireclay brick, cements, monolithic materials, insulations, and definitions of terms are reviewed and applications in industrial furnaces described. A table is given showing basic, acid and neutral refractories, and high and low temperature insulation with their particular fields of application. Ha (6)

Technical Advances and Evolution of Uses of Electric Radiation Furnaces (Progrès techniques et évolution des applications des fours électriques à rayonnement) R. Sevin. *Journal du Four Electrique,* Vol. 45, Apr. 1936, pages 132-137. The latest developments in the furnace previously described (*Journal du Four Electrique,* July 1934), consist in eliminating eddy currents and induction by placing both positive and negative leads at one end of the furnace and leading the current through the electrode by means of a Cu screen placed inside of the furnace housing. Lining of a mixture of zirconite and alumina ("zirconal") is used permitting work at 1650° C. Furnaces work rapidly, and are built up to one ton capacity. Melting pure Fe, Ni and 71% Fe-Cr for 18-8 stainless steel resulted in C content of less than 0.05%. 17 furnaces are already in operation and 8 in the process of construction. JDG (6)

Electrical Annealing and Hardening Furnaces of the Light Metal Industry (Elektrische Glüh- und Vergüteöfen der Leichtmetall-Industrie) U. Schwedler. *Elektrowärme,* Vol. 6, June 1936, pages 171-177. Shaft, trough and continuous furnaces with and without air circulation (convection heating) are described and operating data given. Ha (6)

Modern Refractories in the Steel Industry. L. J. Trostel. *Iron & Steel Engineer,* Vol. 13, Apr. 1936, page 7. Abstract of paper presented and discussed at A. I. & S. E. E. Engineering Conference, Youngstown, Apr. 1936. Analysis of the refractory requirements of the steel industry. WLC (6)

Experiment on a Furnace Roof Arch. C. Wolstencroft. *Heat Treating & Forging,* Vol. 22, May 1936, pages 254, 257. Much difficulty in a large annealing furnace was caused by longitudinal expansion of brick roof rubbing the door when it was raised and lowered. Front part of roof arch and door lining required continuous maintenance. Furnace operated at 1200°-2000° F. The front section of this roof arch was replaced by a precast refractory concrete arch, which was hoisted into position 24 hrs. after pouring. Arch is 13½′ between piers; inner radius is 10¼′ outer radius, 12′ 5″; width, 18″; and overall length, 15′ 8″. It has been in service 1 year. Several cracks have developed which appear to affect neither furnace operation nor arch life. Had fire-brick been used, this part of the roof arch would have been replaced twice in this time. MS (6)

Modern Annealing and Hardening Furnaces for Quantity Production (Neuzeitliche Glüh- und Härte-Oefen für Massenteile) C. Hummel. *Feinmechanik & Präzision,* Vol. 44, June 1936, page 100. Descriptive. Ha (6)

Small Atmospheric Furnaces for High Melting Temperatures. E. L. Harris. *Industrial Gas,* Vol. 15, July 1936, pages 9-10. Temperatures up to 2000° F. can be obtained in small furnaces for carburizing and dental work. Ha (6)

Heat Treatment of Metals. W. Y. Anderson. *Electrical Review,* Vol. 118, June 12, 1936, pages 873-874. Efficiency, cleanliness, and ease of control of electric furnaces and improved quality of work turned out are leading to their increasing use for annealing, hardening, carburizing, tempering, etc. Gives examples of costs, and describes briefly 2 installations. MS (6)

Superheats and Refines Gray Cast Iron. Edwin Bremer. *Foundry,* Vol. 64, Jan. 1936, pages 26-27, 67. Describes a new auxiliary melting unit, an adjunct to the cupola, developed by the Miller Foundry Co., Columbus. The unit is gas fired and of simple construction. VSP (6)

Tempering Furnace with Mechanical-Controlled Convection Currents. *Engineering,* Vol. 142, Aug. 7, 1936, pages 158-159. Describes a gas-heated furnace developed by Despatch Oven Co., Minneapolis. Its operation is based on mechanical convection. A motor driven rotary fan in upper part of furnace drives heat down into heating chamber, from which it passes out for recirculation after giving up heat. Consists essentially of double-walled insulated sheet steel combustion chamber in base of which are the gas burners. Two types are available, one for temperatures from 300°-800° F., and other for temperatures from 300°-1,200° F. VSP (6)

Slab Heating Furnaces at Bethlehem's New Continuous Strip and Sheet Mill. *Industrial Heating,* Vol. 3, July 1936, pages 435-438. The furnaces heat 165 tons of slabs/hr., the slabs being 5 to 16 ft. long and 18 to 50 in. wide; they are heated by a mixture of blast furnace and coke oven gas of 285 B.t.u./ft.^{3} Heat is recuperated by preheating the combustion air to 700°-800° F. Combustion control is described. Ha (6)

Ford Installs the Largest Continuous Electric Furnace in the World. *Industrial Heating,* Vol. 3, Aug. 1936, page 500. Brief description of a bright-normalizing, roller hearth furnace for 7½ tons/hr. of 2335 kw. rating in 3 chambers; total length 325 ft. Ha (6)

Coke Oven Repairs. *Iron & Coal Trades Review,* Vol. 133, July 10, 1936, page 57. Cracks in furnaces were repaired successfully by spraying cement directly onto the hot brickwork. Procedure, mixture of cement, and equipment are described. Ha (6)

The Slag Resistance of Steel Works Refractories. J. H. Chesters. *Iron & Steel Industry,* Vol. 9, Jan. 1936, pages 147-148. The general cause of failure is slag attack. A precise study of the action of slag on steel works refractories would require a great deal of knowledge about equilibrium conditions and reaction rates, which is not likely to be available in the near future. It is possible to carry out comparisons of the slag resistance of various refractories by means of cone and pill tests and by simulating large-scale conditions in a small induction furnace. Physical tests, such as modulus-of-rupture at high temperatures and permeability, enable some idea to be gained of the probable influence of physical factors. CEJ (6)

The Action of Water Vapor on Silica Bricks at High Temperatures, and its Possible Industrial Significance. A. E. Dodd. *Transactions Ceramic Society,* Vol. 35, May 1936, pages 223-243. 9 representative silica brick samples, cut from open hearth furnace bricks, were tested to disruption by exposure to the action of steam, at a temperature of 1500°-1600° C. The bricks failed by plastic flow or local rotting. Microsections of the original samples, and of the test bricks, were examined. It is concluded that a high ferric oxide content causes failure; that a low lime content also appears to accelerate failure; that some volatilization of silica would account satisfactorily for the rotting effects, and that water vapor causes a marked decreaase in the viscosity of the bond. The author discusses the industrial significance of the results obtained. GTM (6)

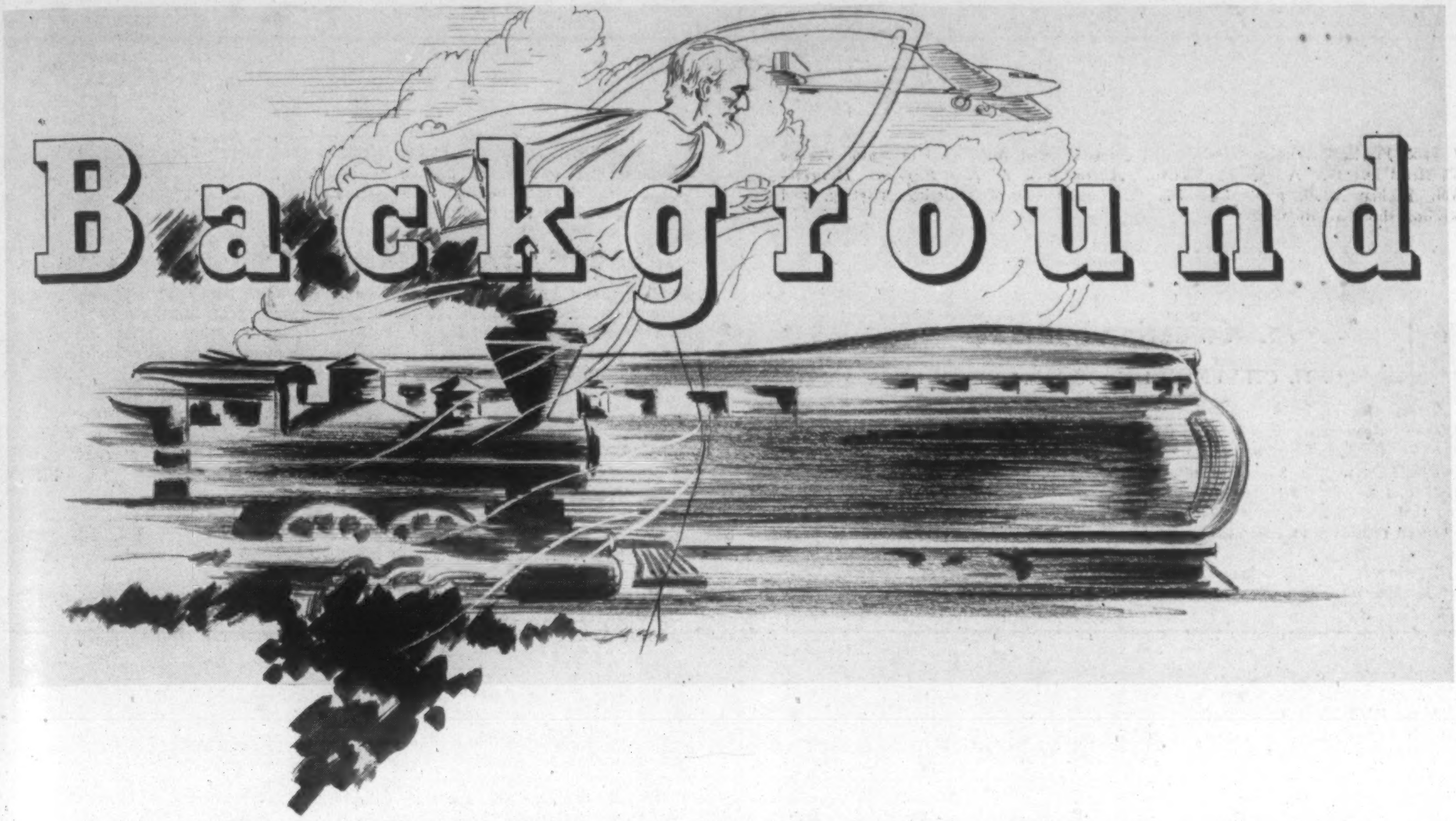
Coke Research. W. Davidson. *Journal West of Scotland Iron & Steel Institute,* Vol. 43, Mar. 1936, pages 117-128. By blending proper materials with the coal before carbonization, the quality of metallurgical coke is improved and satisfactory coke can be made from coals not otherwise suitable. Poor coke may be caused by: (1) a large percentage of volatile matter at the end of the plastic temperature range (450°-550° C.) which results in a weak highly fissured coke; (2) a deficiency of plastic material to bind the coal particles sufficiently to give a non-abradable coke. Coals of high volatile content are blended with finely ground high temperature coke or anthracite. Weakly caking coals are blended with bitumen or pitch. The screening and shatter indices, bulk density, ash content, and chromic acid oxidation value are given for a large number of cokes made from various blends. FGN (6)

The "Deblanchal," a New Rotary Melting Furnace. C. F. Herington. *Iron Age,* Vol. 137, June 11, 1936, pages 50-53, 114. See *Metals & Alloys,* Vol. 7, June 1936, page MA 297R/3. VSP (6)

Recent Developments in Refractories. C. E. Moore. *Metal Industry,* London, Vol. 48, Jan. 3, 1936, pages 8-13; discussion, Jan. 10, 1936, pages 36-37. See *Metals & Alloys,* Vol. 7, July 1936, page MA 348R/4. HBG (6)

The Chill-proofing of Refractory Masses (Beitrag zur Abschreckprüfungfeuerfester Massen) A. Möser. *Feuerungstechnik,* Vol. 24, Jan. 1936, pages 9-10. Methods of simultaneously developing resistance to thermal shock and to corrosion in refractory materials are discussed. FPP (6)

Bituminous Coal for Higher Temperatures in Open-hearth Furnaces. Theodore Nagel. *Blast Furnace & Steel Plant,* Vol. 24, May 1936, page 427; June 1936, pages 523, 542. See *Metals & Alloys,* Vol. 7, July 1936, page MA 348R/6. MS (6)



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7. JOINING

Some Practical Notes on Working and Jointing Sheet Aluminium in Motor Vehicle Construction. II. A. J. T. EYLES. *Aluminium & Non-Ferrous Review,* Vol. 1, May 1936, pages 385-387. The operations of soldering, riveting, and welding sheet Al are discussed. JCC (7)

■ 7a. Soldering & Brazing ■

C. H. CHATFIELD, SECTION EDITOR

Saving of Tin in Soft-soldering (Einsparung von Zinn beim Weichlöten) E. LÜDER. *Feinmechanik & Präzision,* Vol. 44, Mar. 1936, pages 41-42. Sn is, from the German standpoint, a metal to be economized. Soft solders can be made satisfactorily with a Sn solder of 12-15% Sn to which Cd and Bi are added. Tests over 2 years have shown, however, that these solders do not flow very easily, and that certain molecular ratios between Sn and Cd must exist to obtain sufficient corrosion resistance of the soldered joint. Ha (7a)

Experiments with Reaction Solders for Aluminum (Versuche mit Reaktionsloten für Aluminium) NEUBAUER-NICOLINI. *Aluminium,* Vol. 18, Apr. 1936, pages 139-142. The chemical process of a reaction solder with Al, i.e. a salt mixture, out of which a metal constituent, mostly Zn, is deposited in contact with Al upon heating, was investigated. The salt melt etches the Al and thus removes the harmful oxide film. The Al chloride formed in the reaction evaporates together with a part of the volatile compounds of the salt mixture. The strength of soldered joints is better for Zn rich salt mixtures than with Sn rich mixtures. A few reaction solders and their characteristics are given in the table.

$ZnCl_2$%	$SnCl_2$%	NH_4Br%	NH_4Cl%	NaF%	Metal deposition on Al takes place at °C.
90	—	8	—	2	420
90	—	—	8	2	380
—	90	—	8	2	330
90	—	—	10	—	410
—	90	—	10	—	360
45	45	—	10	—	330

Ha (7a)

■ 7b. Welding & Cutting ■

E. V. DAVID, SECTION EDITOR

Flame Cutting of Steel for Welding. *Journal of Commerce, Shipbuilding & Engineering Edition,* July 9, 1936, page 1. A series of experimental tests carried out on V-butt welded specimens having chamfered joints prepared by using the oxy-acetylene cutting flame, and on electrically welded fillets to close square tee joints having the fraying edge of the T member cut by the oxy-acetylene flame, by means of a number of severe alternating impact tests have demonstrated that the flame-cutting preparation has no deleterious effect on the strength of the joint. JWD (7b)

Gas Welding Aluminum and Its Alloys. G. O. HOGLUND. *Metal Industry,* London, Vol. 48, Jan. 3, 1936, pages 5-7. See *Metals & Alloys,* Vol. 7, July 1936, page MA 354R/3. HBG (7b)

Technical Rules for Fusion Welding. General Specifications (Règles Techniques de Soudure Autogène. Specifications Générales). *Revue de la Soudure Autogène,* Vol. 28, Apr. 1936, pages 2-3. Tentative French general specifications established by the "Comité de Normalisation de la Soudure." Following points are covered in these preliminary specifications: (1) Aim and application, (2) guaranty, responsibility of manufacturers, (3) preparation and execution of welds, (4) classification of work, special specifications for particular jobs. FR (7b)

Repair of a Shearing Machine by Bronze Welding (Reparation d'une Cisaille par Soudo-Brasure) *Revue de la Soudure Autogène,* Vol. 28, Apr. 1936, page 16. Typical example of repair of large broken shearing machine frame is described and illustrated. FR (7b)

Bad Welders (Les Mauvais Soudeurs) *Revue de la Soudure Autogène,* Vol. 28, May 1936, pages 2-3. Illustrates good and bad welded joints. It is concluded that welders should follow well established practical rules for welding. FR (7b)

Some Difficulties Encountered in the Practice of Spot Welding (A Propos de Quelques Difficultés dans la Pratique de la Soudure par Points). R. DE LONGCHAMP. *Bulletin de la Société des Ingénieurs-Soudeurs,* Vol. 7, Mar.-Apr. 1936, pages 2123-2130. Lecture before the French Welders' Society. Spot welding machines have to be designed in order to be operated by unskilled labor. Furthermore it is necessary that resistance be constant although constant pressure is of no significance. In spite of the difficulties reviewed, author thinks that spot welding is, economically speaking, without competitor. F R(7b)

Welding on Gas Cut Edges (La Soudure sur Bords Oxy-Coupés) *Revue de la Soudure Autogène,* Vol. 28, May 1936, page 12. This type of welding is quite possible when edges have been very rapidly cleaned with file or chisel. It is not true that the presence of oxide film on the edge prevents the making of correct welded joints. Oxide inclusions are due to unskilled welders and not from state of welded edges. FR (7b)

Conventional Marks for Fusion Welding (Les Signes Conventionnels en Soudure Autogène) *Revue de la Soudure Autogène,* Vol. 28, Mar. 1936, pages 7-9. Discusses difference between international tentative marks adopted at the Würzburg meeting and the French proposals. FR (7b)

Oxy-acetylene in Shipyards. *Shipbuilding & Shipping Record,* Vol. 37, June 11, 1936, pages 774-776; June 18, 1936, pages 809-812. Abstract of a report prepared by the British Acetylene Association. Deals with the application of the oxy-acetylene flame in the building and repairing of ships and the use of oxy-acetylene welding and cutting as applied in marine engineering for the repair of such parts as shafting, propellers and Diesel engine pistons, and for demolition purposes and shipbreaking. JWD (7b)

Oxy-Acetylene Torches (Les Chalumeaux Oxy-Acétyléniques) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène)* Vol. 13, Apr.-May 1936, page 293. Notes on torches with the following trade marks: "Varial", "Primox", "Super Charledave" and "Sauvageau". FR (7b)

Welding of Aluminum (La Soudure de l'Aluminium) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Apr.-May 1936, page 294. Problems met in the welding of Al are discussed. FR (7b)

Bronze Welding of Cast Iron Castings (La Soudo-Brasure des Pièces en Fonte) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Apr.-May 1936, page 290. Practical repairs are illustrated. FR (7b)

Welding of Zinc Coated Sheets (L'Assemblage des Tôles Galvanisées) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Apr.-May 1936, page 291. Practical description of the 2 methods available. FR (7b)

Welded Bridges and Overhead Structures (Constructions Métalliques Soudées) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Jan.-Mar. 1936, page 285. Typical examples are illustrated. FR (7b)

Applications of Cutting Torch (Les Applications du Chalumeau Coupeur) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Jan.-Mar. 1936, page 286. Typical practical applications are given. FR (7b)

Welding of Copper (La Soudure du Cuivre) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Jan.-Mar. 1936, page 283. Principles for welding of thin, medium and thick Cu sheets and plates. FR (7b)

Automatic Oxy-Acetylene Welding (La Soudure Oxy-Acetylenique Automatique) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Jan.-Mar. 1936, page 284. Describes briefly "Sa Frap" welding machines. FR (7b)

Welding of Piping (La Soudure des Canalisations) *Soudure et Oxy-Coupage (Supplement to La Revue de la Soudure Autogène),* Vol. 13, Jan.-Mar. 1936, page 282. Practical article giving chief principles to be observed. FR (7b)

Resistance Flash Welder Increases Production of Broad Strip Mill. *Steel,* Vol. 98, May 11, 1936, page 56. Welder joins strip into a continuous piece that can be pickled and processed without interruption. Strip to be pickled is unreeled and passed into a looping pit which holds enough stock to allow 1 min. for welding ends together. Rear end of coil is squared off in an upcut shear and front end of another coil is trimmed off similarly and fed into welder. Ends are lined up by gages, and, at touch of a control button, are clamped in place while current goes on and off. After completion of weld, strip moves along until joint is in position in a trimmer, where burr is removed by a pull shear before strip passes into looping pit. MS (7b)

Tests with Coated Filler Metal Bars (Note sur Quelques Essais de Métaux d'Apport Enrobés) JEAN BRILLIÉ. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 7, Jan.-Feb. 1936, pages 2030-2033. Lecture before the French Welders' Society. Conclusions of the author are: Coating improves quality of welds obtained but chief advantage of coating rods is the ease of welding for the operator who can speed up his production. It also reduces amount of flux used for welding non-ferrous metals. FR (7b)

Flame-cutting in Artcraft (Brenschneiden im Kunsthandwerk) J. BLÜMMEL. *Autogene Metallbearbeitung,* Vol. 29, June 15, 1936, pages 182-183. Examples illustrate possibilities and artistic effects obtainable in decorative arts. Ha (7b)

Welding in Strip Mill Practice. J. SELWYN CASWELL. *Sheet Metal Industries,* Vol. 10, Apr. 1936, pages 327-329. The welding of rolled strip to increase the weight of coils or to maintain the continuity of movement through the processing stages is discussed. Fabrication and maintenance of plant are treated to show the possibilities for the increased use of welding. AWM (7b)

The Oxwelding of Non-ferrous Metals and Stainless Steel. W. A. DUNCAN. *Iron & Steel of Canada,* Vol. 19, June 1936, pages 5-11. Welding of non-ferrous metals and their characteristic behavior in welding is discussed at length, it is emphasized that the more numerous metals and alloys become used in modern industry the more important it is that they possess good weldable properties as welding must be considered just as useful a tool to the non-ferrous artisan as it is to the steel manufacturer. Al, brasses, bronzes, Monel metal, stainless steels are treated individually; the beneficial effects of Co and Ti as addition elements to the welding rod for prevention of intergranular corrosion are explained. Ha (7b)

Classification of Welders (La Classification des Soudeurs) *Revue de la Soudure Autogène,* Vol. 28, June 1936, page 2. Necessity for classification of welders results from recent social movement which wishes to establish wage rates for different kinds of labor. FR (7b)

Application of New Oxy-Acetylene Welding Methods (L'Application des Nouvelles Méthodes de Soudure Oxy-Acétylénique) *Revue de la Soudure Autogène,* Vol. 28, Mar. 1936, page 6. Application of hand and machine welding by the double seam process in the manufacture of pressure vessels. FR (7b)

Review of Technical Literature on Fusion Welding (Revue de la presse de la Soudure Autogène) J. FASSBINDER. *Bulletin de la Société des Ingénieurs-Soudeurs,* Vol. 7, Mar.-Apr. 1936, pages 2153-2163. Lecture before the French Welders' Society. Reviews typical applications of welding. FR (7b)

Foreign Countries Lead U. S. in Welded Bridges. LA MOTTE GROVER. *Engineering News-Record,* Vol. 116, May 14, 1936, pages 703-709. A review of European accomplishments of the last 5 years shows that many structures have been welded of which there are no counterparts in American practice. CBJ (7b)

Welding Methods for the Non-Ferrous Metals. H. W. G. HIGNETT. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 92-98. The author compares the welding of non-ferrous metals with that of ferrous metals. He lists, in order of importance, as factors which influence the choice of welding process for non-ferrous metals: (1) metallurgical, (2) thermal, and (3) economic. Available methods discussed are (a) oxy-hydrogen and oxy-coal gas, (b) oxy-acetylene, (c) C arc welding, (d) metallic arc welding, (e) atomic H welding, (f) electric resistance spot and seam welding, and (g) butt and flash welding. 32 references. HBG (7b)

Welding of Boilers of the Steamer "France" (Les Soudures des Chaudières du Paquebot "France") MAURICE LEBRUN. *Bulletin de la Société des Ingénieurs-Soudeurs,* Vol. 7, Mar.-Apr. 1936, pages 2131-2133. Lecture before the French Welders' Society. Short descriptive account. FR (7b)

Some Applications of Welding in the Works of the French "Orleans" Railway Company (Quelques Applications de la Soudure dans les Ateliers de la Compagnie d'Orleans) R. LABORIE. *Bulletin de la Société des Ingénieurs-Soudeurs,* Vol. 7, Mar.-Apr. 1936, pages 2091-2121. Lecture before the French Welders' Society. Study is made of: (1) Electric arc welding; among examples given is the complete welding of a steel firebox and the repair of a locomotive frame, (2) welding using both arc and torch welding; examples given comprise repair of a cast Fe cylinder and complete building up of a locomotive cylinder, (3) electric resistance welding; typical examples for part manufacture such as connecting and piston rods as well as for tool reclaiming and frame work construction are reviewed. Last section deals with installation of welding shops and with training of welders at the "Orleans" Company. FR (7b)

A Few Considerations for Further Research on Low-temperature Steel Welding. E. LEWIS. *Iron & Coal Trades Review,* Vol. 132, June 26, 1936, page 1156. A new welding process is described based on the fact that the higher the C content of a steel, the lower will be its melting point. A special patented type of welding blowpipe is used the tip of which has 2 additional preheating flames situated about half way up the nozzle which are to prepare the joint for the actual welding operation. The necessary C to lower the melting temperature of the surface is obtained by an excess of acetylene in the flame. Tests showing the very good mechanical properties of such welds are described. Ha (7b)

Fusion Welding in Railway Shop (La Soudure Autogène dans les Ateliers des Compagnies de Chemins de Fer) R. MESLIER. *Revue de la Soudure Autogène,* Vol. 28, Mar. 1936, pages 2-5. It is said that manufacturing shops of railway companies are now using very intelligently all the welding processes. Cu and steel fire-box manufacture is described and abundantly illustrated. FR (7b)

Welding of Rails on the Permanent Way. M. MICHAUD. *Iron & Coal Trades Review,* Vol. 132, June 26, 1936, page 1158. Welding methods used at present for the maintenance of railroad tracks are reviewed and compared. Ha (7b)

Welding of Rail Tracks (La Soudure des Rails) JEAN NÈGRE. *Bulletin de la Société des Ingénieurs-Soudeurs,* Vol. 7, Mar.-Apr. 1936, pages 2135-2152. Lecture before the French Welders' Society. Operations are conducted as follows: (1) Bottom and upper surfaces are cleaned, (2) rails are set in position, (3) weld is made, (4) power is maintained during a predetermined time in order to decrease brittleness of metal, (5) cleaning is performed by compressed air chisel, (6) upper part is finished by a special hot cutter, (7) grinding is then resorted to, using a portable compressed air grinder, (8) 2 workers can handle 60 m. rail length without difficulty. FR (7b)

The Welding School of the French State Railways at Le Mans (L'Ecole de Soudure des Chemins de Fer de l'Etat au Mans) PIERRE ROSEMBERG. *Revue de la Soudure Autogène,* Vol. 28, May 1936, page 13. Brief data about the school. FR (7b)

Resistance Welding the Light Alloys. R. SALELLES. *Metal Industry,* London, Vol. 47, Nov. 15, 1935, pages 489-493. Article is translated from *Revue de la Soudure Autogène.* The author gives details of a resistance welding process recently developed in France. He describes results obtained by Sciaky Electric Welding Machines, Ltd. in welding of Al, Duralumin, Vedal, etc. The general theory of resistance welding is briefly discussed. The special machines believed necessary for spot-welding Al and its alloys are described, methods of their operation are discussed and reasons suggested for certain requirements. The advantages of this type of welding are emphasized. The article is illustrated. HBG (7b)

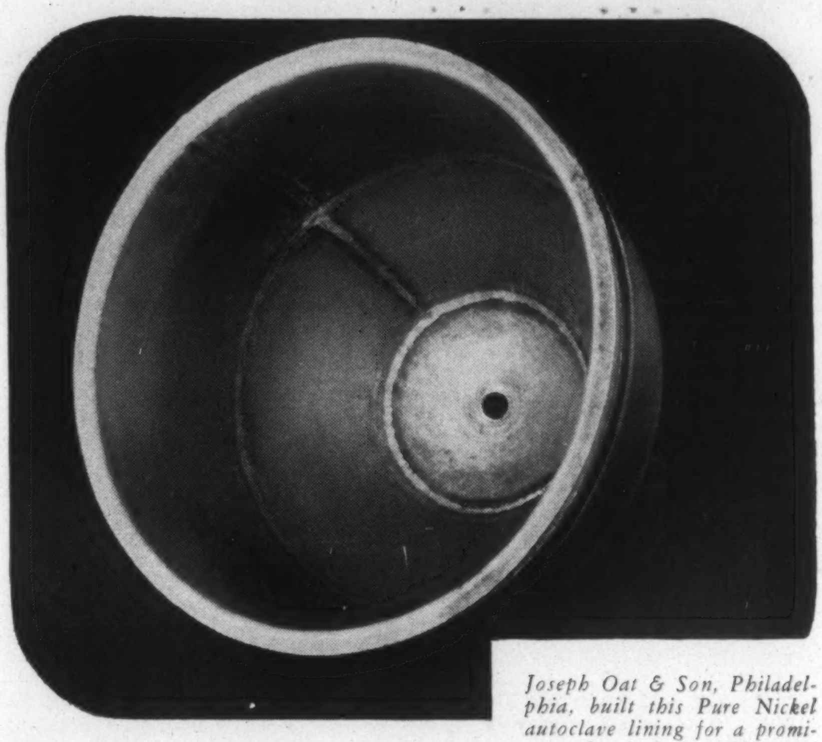
At the Paris Show (A la Foire de Paris) R. SALELLES. *Revue de la Soudure Autogène,* Vol. 28, June 1936, pages 3-9. Describes and illustrates new welding appliances and machines as seen at the recent Paris show. FR (7b)

High Pressure Arcs. C. G. SUITS. *General Electric Review,* Vol. 39, Apr. 1936, pages 194-200. Characteristics, temperatures, thermal equilibrium, and current conduction of arcs including welding arcs are discussed. CBJ (7b)

HOW DID THE MAKERS

WELD

THIS NICKEL LINING?



Joseph Oat & Son, Philadelphia, built this Pure Nickel autoclave lining for a prominent chemical plant. This shell is 48" dia. x 40" deep, made of 1/8" thick standard Nickel sheet with all joints gas welded, using Inco Nickel Gas Welding Wire No. 41. This is typical of welded Nickel linings for many types of chemical and food processing equipment.

Without a flux . . . With Inco gas welding wire No. 41 . . . With a tip one size larger than for steel

HERE'S a neat job—an autoclave lining of Pure Nickel, gas welded. A chemical plant needed the strength, the toughness and corrosion resistance that Nickel gives . . . and welding furnished the answer to "How Build the Machine."

When you need Nickel or Monel in one of your machines, remember these metals can be welded. And by all the methods commonly used on steel.

Any good welder can handle Monel and Nickel as easily as steel . . . only he must handle them differently from steel. The little details of difference that matter he must know.

For instance; in the job shown here the welder used no flux. That's because he was welding Nickel, and a flux with Nickel can cause brittleness. But to weld Monel, you should use a flux, to avoid discoloration and to improve fluidity.

The answer is, write Inco, and ask for "Technical Bulletin T-2," which gives full instructions for welding these two metals. You can have your replacements fabricated right in your own plant if you wish. Ask us for the name and address of the fabricator nearest you.

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NICKEL

Monel is a registered trade-mark applied to an alloy containing approximately two-thirds Nickel and one-third copper. This alloy is mined, smelted, refined, rolled and marketed solely by International Nickel.

MONEL

Multiple Arc Welding Sets. C. J. Holslag. *Welding Journal,* N. Y., Vol. 15, June 1936, page 23. Note on space saving and other economies in use of multiple arc instead of set for each man or each operation. WB (7b)

Gas-fusion Welding of Special Workpieces (Gasschmelzschweissung besonderer Werkstücke) W. Hönisch. *Autogene Metallbearbeitung,* Vol. 29, June 15, 1936, pages 181-182. Examples of a ship's anchor and the jaws of a rock crusher which were repaired by autogenous welding are described. Ha (7b)

Inspection of Welded Seams in Pressure Vessels. W. D. Halsey. *Welding Journal,* London, Vol. 33, Mar. 1936, pages 78, 80. See *Metals & Alloys,* Vol. 7, June 1936, page MA 299L/1. WB (7b)

Autogenous Welding in Railway Material (La Soudure Autogène dans le Matériel de Chemin de Fer) Laborie. *Usine,* Vol. 45, Apr. 23, 1936, pages 29-31. Practices in French railway shops are described; particular attention is paid to training of personnel. Ha (7b)

Low Alloy, High-Tensile Steels. A. B. Kinzel. *Welding Journal,* N. Y., Vol. 15, May 1936, pages 24-27. Review of desirable physical properties of low alloy steels, combining good ductility and high strength. The various alloys are grouped and their effect on hardening propensity and grain growth susceptibility of the alloy steel during welding indicated. Weldability of the steels are discussed from engineering viewpoint and the metallurgical quality of the various sections of the transition zone next to the weld bead detailed. Zone of largest grains is not considered to be a dangerous structure due to short duration of weld heat. Zone of recrystallization considered to be a dangerous one due to heating to austenite range and rapid quench. WB (7b)

Arc Welding Apparatus. E. Steinert & W. W. Reddie. *Iron & Steel Engineer,* Vol. 13, Jan. 1936, pages 9-12. Welder is described incorporating advantages of main contactor on primary side with a smaller contactor, operators are not required to hold in the control switch while welding, control starts with button switch, load loss negligible and welding terminals are automatically de-energized when welding ceases which increases safety. WLC (7b)

Present Status of Electric Welding in Germany (Der heutige Stand der Elektroschweissung in Deutschland) K. Siemers. *Elektrowärme,* Vol. 6, June 1936, pages 195-198. Particular progress was made in the butt-upset resistance welding process for small parts, wires and non-ferrous metals. Machines operating entirely automatically are made now for sections up to 25,000 mm.^{2} and for spot-welding with about 200 points/min. for sheets of 3-4 mm. thickness. Ha (7b)

The Nature of Fluxes and Their Effect on Weld Metal. T. C. R. Shepherd & M. R. Moritz. *Sheet Metal Industries,* Vol. 9, Nov. 1935, pages 721-722; Dec. 1935, page 788. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 129L/10. AWM (7b)

Welding of a Preheated Cast Iron Cylinder (Gusseisenwarmschweissung eines Zylinders) Scholz. *Autogene Metallbearbeitung,* Vol. 29, June 1, 1936, pages 171-172. The procedure used in repairing a crack of 1000 mm. length is described in detail. The cylinder was preheated by charcoal fire to red heat and welded with the oxy-acetylene flame, and then slowly cooled in about 60 hrs. Ha (7b)

Fabrication of Cast and Rolled Steel. J. M. Sampson. *Transactions American Foundrymen's Association,* Vol. 7, Apr. 1936, pages 351-366. Tests were made to obtain physical data for welded joints of cast steel to cast steel, cast steel to hot rolled steel, either as bar or platestock, and cast steel to cold rolled steel. The cast steel used in these tests varied in C content from 0.31 to 0.39% and the rolled steel was the usual material available in the factory. Most of the joints were arc welded by the use of bare electrode, type L, and fluxed electrodes, types W-20 and W-21. Some joints were flash welded. 4 general types of tests were used: Tension, shear, bending, and fatigue. It was concluded that cast steel may be welded to cast steel or to rolled steel either by arc welding with fluxed electrodes or by flash welding regardless of the character of surface preparation, with entirely satisfactory results. While annealing reduces the tensile strength, it increases ductility, and the best results are obtained when heat treatment is applied after the structure is completely welded. All specimens of cast steel welded to plate stock failed in plate stock with all types of electrodes. CEJ (7b)

Tests on Welded Silicon Steel. M. R. Taylor & Jonathan Jones. *Welding Journal,* N. Y., Vol. 15, May 1936, pages 31-33. Analysis of steels of unknown weldability which were used as deck plating for part of Triboro bridge showed:

	C	Mn	Si	P	S
plates	.29	1.0	.23	.013	.024
7″ beams	.27	.95	.26	.020	.035

Good weldability was shown in tests which are described and discussed. WB (7b)

Thermit Welding under Traffic. John B. Tinnon. *Transit Journal,* Vol. 80, June 1936, page 166. Thermit welding under traffic may be accomplished by the insert method or by the undercut method. In the insert method an insert cut from a piece of rolled rail steel is placed between the rail heads at the running surface, while in the undercut method a gap is cut in the webs, bases and lips of the rails and the overhanging ends of the rail heads form an attached insert and are butt welded together. 17 steps of effecting the weld are listed. WHB (7b)

7c. Riveting

Concerning the Use of Pneumatic Riveting Hammers. *Compressed Air Magazine,* Vol. 41, Apr. 1936, page 5013. Manual riveting is most desirable when less than 50 rivets are to be driven; pneumatic equipment should be used for more than 100. Method used for intermediate jobs depends on individual conditions. FPP (7c)

Riveting Aluminium. A. J. T. Eyles. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, page 329. Workshop notes. JCC (7c)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Metallurgical Progress and the Finishing Industry. *Synthetic & Applied Finishes,* Vol. 6, Feb. 1936, pages 265-266, 287. Metallurgical developments affecting the finishing industry in 1935 are reviewed. Electrodeposition of Zn from solutions obtained by leaching roasted Zn ore; improvement in electrodes for welding mild steel plate; plating of metals on nonmetals; bright annealing developments; electrodeposition of Re, Te and Cd-Zn; hard-facing of metals for superior abrasion resistance; Ni clad steel, mirror finished automotive cylinder barrels, and metallizing, are each briefly discussed. FPP (8)

8a. Pickling

Pickle Pitting by Electrolytic Potentials as Affected by Scaling Temperature. C. H. McCollam & D. L. Warrick. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 133-153; *Heat Treating & Forging,* Vol. 21, Oct. 1935, page 484. Paper and discussion from the Chicago Convention of the Society, 1935. Data are presented to show that pitting during pickling is associated with electrolytic action between scale and metal. Potential of scale was found to be a function of scaling temperature. At lower temperatures the potential is practically the same as that of the metal and pitting is absent, but at higher temperatures the difference in potential is marked and deep pitting is likely to occur. The boundary between these temperature ranges roughly coincides with the transformation temperature. Mechanical scale breaking before pickling tends to lessen depth of pickle pits. Inhibitors modify the electrolytic action but do not prevent deep pitting. WLC + MS (8a)

Equipment for Wide Strip Pickling System Rubber Lined. *Steel,* Vol. 98, May 11, 1936, pages 53-54. Equipment in River Rouge plant of Ford Motor Co. handles strip up to 78″ in width. There are 2 240-ft. lines of welded steel tanks, lined with rubber which is covered with inner lining of acid-proof brick jointed with special S-base cement. Pb siphons are used for emptying tanks into steel sewer. Strip is supported between tanks by steel carrier rolls, under which are steel drip-pans. All acid tanks have sectional, flanged steel covers. Steel ducts carry fumes from center of each tank to H_2O spray tanks, in which countercurrent washing and cooling of fumes remove all acid. All steel equipment is rubber lined. MS (8a)

Inhibitors in Pickling. P. R. Russell. *Journal American Zinc Institute,* Vol. 17, 1936, pages 81-87. A good inhibitor must give a bright finish free from non-rinsable discolorment, stain, or film. It should maintain satisfactory inhibition throughout the life of the pickling bath. Many inhibitors give high initial inhibition but the action drops off sharply in a very short period. No obnoxious odors or fumes should be given off, and the inhibitor should not cake in shipping containers. An inhibitor must be easily soluble and should not be so active that the action of the acid on the scale is slowed up enough to impair operating schedules. A moderate passivating effect is desirable to prevent discoloration during exposure between pickle and rinse. A good inhibitor results in an overall reduction of 30 to 40% in acid consumption. Under ideal pickling conditions and by proper use of inhibitors the acid consumption should be about 90 lbs./ton of 26 gage sheet. Most inhibitors are complex organic compounds. BHS (8a)

8b. Cleaning including Sand Blasting

Cleaning Before Plating. Terrence A. O'Neil. *Metal Progress,* Vol. 29, June 1936, pages 59-64. Description of cleaning methods and discussion of the importance of thorough cleaning in preparation for electroplating of metal parts. WLC (8b)

Diluents and Solvents used in Industry, and Their Physiological Effects (Os Solventes empregados na Industria, e seus Effeitos physiologicos) C. E. Nabuco de Araujo, Jr. *Revista Brasileira de Chimica,* Vol. 1, June 1936, pages 251-252. The toxicity of diluents and solvents used in painting, electroplating and cleaning processes are reviewed, and the amounts of vapor in the air seriously affecting health are tabulated for benzine, carbon tetrachloride, gasoline, chloroform, and other hydrocarbons. Ha (8b)

8c. Polishing & Grinding

Canadian National Grinds Driving Axle Journal. M. M. McCall. *Iron Age,* Vol. 137, May 14, 1936, pages 37-42. Describes method and equipment used by the Canadian National Railways in grinding journals on locomotive driving axles. Burnishing is still the accepted practice in the United States. Grinding is done on 90″ combination journal turning and grinding machine. Advantages claimed for grinding; (1) more accurate and better finish; (2) greater freedom from hot boxes; (3) material increase in life of axle; (4) 125,000 miles of operation without grinding of journals; and (5) increased production. VSP (8c)

Surface Grinding in the Tool Room. Fred B. Jacobs. *Abrasive Industry,* Vol. 17, May 1936, pages 11-15. Errors in grinding due to wheel wear have been reduced. Many types of surfacing grinders are shown for large and small jobs and their operation briefly described. WB (8c)

8d. Electroplating

Bright Deposition of Cobalt. A. Chaybany. *Electrometallurgy,* supplement to *Metal Industry,* London, Vol. 48, June 26, 1936, pages 721-722. On the basis of the theory that matte deposits are composed of metal containing traces of hydroxide or basic salts and that bright deposits are purer metal, the author studied the problem of bright deposits of Co. This required (1) the prevention of the precipitation of $Co(OH)_2$ or (2) the suppression of the evolution of H. The former may be accomplished by acidifying the bath, the addition of acid alcohols or organic polyalcohols, or the regeneration of acidity at the cathode by reduction of the SO_4-ion. In a bath composed of :

Cobalt-ammonium sulphate	200.00 grams,
Pure H_2SO_4	10.00 grams,
Hydroquinone	.20 grams,
Sodium hydrosulphite	.05 grams,

the deposits obtained were sufficiently bright that subsequent polishing was unnecessary. Suppression of the evolution of H was attempted by introducing into the bath salts of metals having higher over-voltage such as Hg, Zn, Cd, and Sn, and also certain commercial inhibitors such as colloids, aldehydes, formaldehyde, derivatives of thio-urea and of quinoline. White deposits of Co were obtained with these inhibitors but none were as satisfactory as that obtained in the presence of hydroquinone and of Na hydrosulphite. In a bath containing a metal of high over-voltage and one of these inhibitors, deposits of mirror-like brilliance were obtained. For depositing Co at temperatures below 25° C., the author uses a bath of the following composition:

Cobalt-ammonium sulphate	200.00 grams
Neutral ammonium acetate	30.00 grams
Free acetic acid	1.00 grams
Formaldehyde	3.00 grams
Cd sulphate	0.2 grams
Water	1 liter

For plating at higher temperatures the Cd sulphate must be increased. HBG (8d)

Adventures in Electroplating Copper from Ammoniacal Solution. E. A. Vuilleumier. *Monthly Review American Electroplaters' Society,* Vol. 23, Feb. 1936, pages 44-50. By electrolyzing a solution containing 25 g. $CuSO_4.5H_2O$, 60 cc. conc. NH_4OH in 1 l. H_2O at 6 milliamps./cm.^{2}, a dense, bright, satisfactory Cu deposit resulted. When the cell was allowed to stand overnight and then electrolyzed, a coarse, loose, moss-like deposit of Cu crystals was obtained. This change in behavior was attributed to the fact that Cu anode was allowed to remain in solution. Cuprous oxide was formed which produced a film on the cathode, which, it is thought, was discontinuous. Cu electrodeposited through the holes in the film gave rise to the spongy deposit. Remedy consisted in adding excess conc. NH_4OH, or $(NH_4)_2SO_4$ plus dilute NH_4OH to the solution. Cuprous oxide was then dissolved and good deposits were again obtained. GBH (8d)

The Basic Theory of the New "Bethanizing" Process. U. C. Tainton. *Wire & Wire Products,* Vol. 11, May 1936, pages 225-227, 243. "Bethanizing" is a process of electro-depositing very pure Zn (99.9975%) on Fe or steel. It is plated onto the steel directly without the use of an intermediary Al cathode. The raw material is a roasted Zn concentrate of 50-60% Zn, in which are present also Cd, Cu, Pb, Ag and Au; Fe, Ni, Co and Mg; Al, Ga, In, and Th, Si and Ge, As and Sb, O, S, Te; Mg, Ca, Cl and F. The electrolyte carries about 250 g./l. of free H_2SO_4. During the first stages of operation most of the foreign elements pass into solution, and with continued addition of Zn-bearing material the acid concentration diminishes and gradually approaches neutrality. The reactions up to this point which are complex are described at length. The deposition of Zn at this stage is possible but only by applying an overvoltage in order to utilize the property of Zn to oppose the development of H under this condition. A new pickling method developed for steel consists in use of a fused salt bath (NaOH) to avoid occlusion of H in the steel and to obtain the absolutely clean surface required. Electrolysis is carried out at current density from 700 to 2000 amp./ft.^{2} The anodes consist of a Pb-Ag alloy. Special polishing and densifying dies were developed for the Zn coating. The whole process as developed in the Bethlehem Steel Co. is described in full. Ha (8d)

8e. Metallic Coatings other than Electroplating

Some Practical Aspects of Galvanizer Dross at High Temperatures. *Iron & Steel of Canada,* Vol. 19, Feb. 1936, pages 11-12. The sources of Fe accumulating in galvanizing baths are discussed. The Zn usually contains less than 0.08% Fe; the latter is carried into the bath of molten Zn by Fe salts from pickling and by corrosion of the Fe surface when drying after pickling. The dross changes in character when the pot is at high temperature; in some cases the temperature has been so high (1000°-1500° F.) that the dross is entirely crystalline in texture, called "sandy." The proper bath temperature and galvanizing conditions will always produce a dross that has the long, slender, needle-like rhombohedral form of crystal and such conditions also assure longer life of pots and better operating conditions. Ha (8e)

Surface Protection Symposium and Exhibit of Surface Protection Technique in Austria (Oberflächenschutz-Tagung und Ausstellung "Oberflächenschutztechnik in Österreich") *Montanistische Rundschau,* Vol. 28, June 16, 1936, 4 pages. A review of a meeting and exhibit held at the Montanische Hochschule in Graz-Leoben, Austria, May 7-9, 1936. Deals mainly with galvanizing, parkerizing, the Schoop metal-spraying process, and enamelling. Very little new information is given. BHS (8e)

Cementation with Beryllium (La cementation par le glucinium) J. Laissus. *Métaux,* Vol. 11, Mar. 1936, pages 48-59. See *Metals & Alloys,* Vol. 7, June 1936, page MA 304R/4 and Vol. 6, Mar. 1935, page 120R/8. GTM (8e)

The Metallization of Machine Elements. W. E. Glidden.* *Iron Age,* Vol. 137, Apr. 9, 1936, pages 49-51, 132; Apr. 16, pages 31-33, 53. Describes metal spraying of machine elements which must subsequently stand up under grinding and machining operations. The porosity of sprayed coating which is considerably greater than that of hot-dip or electroplated coatings may be overcome by mechanical, thermal or chemical means. Surface preparation, blasting with steel grit or sand, before spraying, is of greatest importance. Surface coating must be applied right after cleaning. Second instalment gives results of tests on adhesion of coating, effect of heat treatment, resistance to corrosion and limitations of process in coating small pipes. Order of resistance to corrosion of coatings tested i:s (1) Zn; (2) Cd; (3) Al; (4) Sn; (5) stainless steel; and (6) Cu. VSP (8e)

8f. Non-Metallic Coatings

Reaction Between Paint Films and Zinc Surfaces. Henry J. Wing. *Industrial & Engineering Chemistry,* Vol. 28, Feb. 1936, pages 242-243. This study shows definitely that reactions can take place between Zn surfaces and the oxidation products formed in the drying of oil or varnish type finishes. Compounds formed as a result of this reaction are actually present on paint films which peel from galvanized surfaces. Zn formate has been definitely identified as one of these compounds. Presented before the Division of Paint and Varnish Chemistry at the San Francisco Meeting of the American Chemical Society, Aug. 1935. 20 references. MEH (8f)

Improved Coatings for Duralumin. Herbert Chase. *Aero Digest,* Vol. 28, May 1936, page 40. Brief resume of some tests on anodic film, paint, lacquer and pigment coatings on duralumin. Specimens remained in 20% salt spray without failure for more than 4700 hrs. Best coating is paint vehicle with Al powder. WB (8f)

Highly Heat-Resistant Anti-Rusting Finishes. F. J. Peters. *Synthetic & Applied Finishes,* Vol. 6, Dec. 1935, pages 230-232, 235. Complete, detailed discussion of comparatively heat-resistant, rust-inhibiting coatings for steel. Optimum combination of rust-protecting vehicle and heat-resistant pigment is difficult to select and produce. A vehicle that merely turns brown or burns away completely at an elevated temperature is practicable; charred coatings are unsuitable. Between 300° and 400° C. low-oil rosin or ester gum varnishes that burn away and synthetic resin (e.g. durophene) that is scarcely affected are suitable. Practically, only white and black pigments remain unchanged in color at high temperatures, although Cd red, green Cr oxide and burnt umber are unaffected at 400° C. Best all-around qualities are offered by Al powder or Zn dust in a vehicle that completely burns away. Al is believed to form a compound with Fe at the surface; above 700° C. "calorizing" occurs but rust protection is decreased. Metal-pigment paints do not afford perfect rust protection but the combination of heat and rust resistance is satisfactory. The advantages of multiple-coat finishes are discussed. FPP (8f)

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9. TESTING

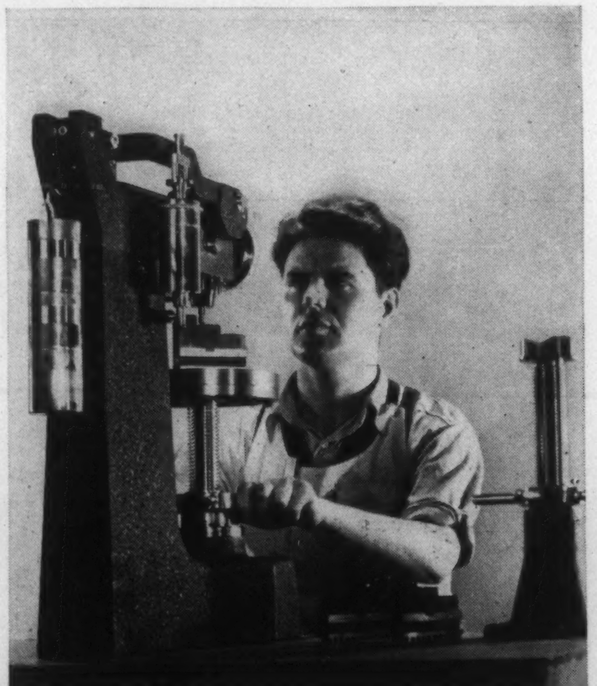
Testing Steels by Sparking. De Bary Kerston. *Scientific American,* Vol. 154, Mar. 1936, page 125. Increase in C content increases the "bursts" on sparking. Mo gives an orange colored spear at the end of every carrier line. Ni gives tiny blocks of brilliant white light. Si suppresses the C spark. High W steels give a dull red spark. CBJ (9)

9a. Inspection & Defects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

Scale for Estimation of Slag Inclusions in Iron and Steel (En skala för bedömning av slagginneslutningar i järn och stål) Bertil Rinman, Hans Kjerrman & Bengt Kjerrman. *Jernkontorets Annaler,* Vol. 120, June 1936, pages 199-226. The scale adopted by the Swedish Ironmasters' Association is described. It consists of a series of micrographs showing various typical fields of view, arranged in groups (A, B, C, D) with regard to form and distribution of inclusions, and numbered (1, 2, 3, 4, 5) according to quantity. In applying this method a micrograph of the specimen is compared with a micrograph of the scale. The actual diameter of the field of view must be 0.8 mm. and the magnification 100 diameters when a focusing screen is used. Without such a screen a magnification of 150 diameters is required. The scale in full size (80 mm. diameter) with complete description in English, French, or German can be obtained from Jernkontoret, Stockholm 16, Sweden. HCD (9a)

X-ray Stress Measurements on Quenched Steel Shafts (Röntgenographische Spannungsmessungen an abgeschreckten Stahlwellen) F. Wever & H. Möller. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 18, No. 3, 1936, pages 27-30. The lattice constants of the material were determined by vertically incident X-rays and then the accuracy of the derived stresses compared with mechanical measurements (by boring out layers from the shaft by the Sachs method). The 2 methods give different absolute values for the stresses, but agree as to change in stress during the boring out process. This results from additional stress (tensional, 40 kg./mm.^{2}) extending about 0.2 mm. below the outer surface, which are measured by the X-ray and not by the mechanical method. When the stressed layer is etched off the methods agree. Ha + CSB (9a)



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Examination of Metal Coatings for Porosity. I, II, III. Nathaniel Hall. *Platers' Guide,* Vol. 32, Mar. 1936, page 12; Apr. 1936, pages 13-14; May 1936, page 30. Rough chemical tests for porosity are based on 2 reactions: (1) involves the selective corrosion of the basis metal at the pore and its solution in the testing reagent, and (2) involves either displacement of gas or another metal from the solution, or the reaction of the dissolved basis metal with one of the constituents of the solution to form a colored pigment. The $CuSO_4$ test for Cr plate, the dimethylglyoxime test for Cr plate and the ferroxyl test for coatings on Fe and steel are outlined, as well as the so-called Frigidaire solution test and tests for Ni on brass and Cu. The Frigidaire test depends upon the fact that trichloracetic acid will dissolve Cu. Zn and Al coatings may be tested by immersion in either acid or alkaline solution. For Zn a warm 25% NaOH solution or a .25% HCl solution (by volume) may be used. For Al a 5% NaOH or a 5% HCl solution is advisable. WHB (9a)

Iron Oxide Printing. Roland Mitsche. *Metal Progress,* Vol. 29, Mar. 1936, page 69. Describes method of printing oxide inclusions on gelatine paper moistened with dilute HCl and developed with $K_4Fe(CN)_6$ solution. See also "Detection of Oxide Inclusions in Steels by Imprint Methods," *Metals & Alloys,* Vol. 7, June 1936, page MA 307L/1. WLC (9a)

Difficulties in Determining the "Physical Purity" of Steel. Albert Portevin. *Metal Progress,* Vol. 29, May 1936, pages 68-69. Use of examination of polished surfaces for determination of physical purity is dependent on the human factor and the usefulness is limited to employment by the same operators in one plant. WLC (9a)

Ultra Sound Waves for Locating Inner Defects. B. M. Suslov. *Metal Progress,* Vol. 30, July 1936, pages 60-61. Supersonic vibrations from the inverse piezoelectric effect in quartz due to the application of high frequency alternating voltage are used. Ripples in oil or Hg caused by waves passing undamped through the material may be photographed. Such photographs provide a map of inner defects. WLC (9a)

Testing Materials for Railway Use. R. K. Linach. *Iron & Steel of Canada,* Vol. 19, Feb. 1936, pages 13-16. Methods used by Canadian railroads are described. Ha (9a)

Flakes in Steel Forgings. *Metal Treatment,* Vol. 2, Spring 1936, pages 14-16, 23. Abbreviated translation of two papers from *Revue de Métallurgie.* See "Formation of Flakes in Chromium-Nickel-Molybdenum Steels," *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 197L/5, and "Flakes in Forged Steel," *Metals & Alloys,* Vol. 7, June 1936, page MA 286R/7. JCC (9a)

Flakes in Forging Caused by Hydrogen. I. Musatti & A. Reggiori. *Metal Progress,* Vol. 30, July 1936, pages 51-56. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 197L/5. WLC (9a)

Controlled Welding in Boiler Making (La Soudure Controlée en grosse chaudronnerie) R. Lemaire. *Usine,* Vol. 45, Mar. 26, 1936, page 29. Methods are reviewed for testing welds in large boilers during welding operations where destruction test methods cannot be employed. Radiography is most satisfactory as even very small defects, inclusions and blisters are easily detected. Bending tests with welded boiler plate specimens can also be employd. The method is described. Ha (9a)

X-ray Measurement of Elastic Stresses (Röntgenographische Bestimmung elastischer Spannungen) W. E. Schmid. *Archiv für Technisches Messen,* Vol. 5, May 1936, page T57. Description of absolute determination of elastic stresses without destroying the piece, by X-rays directed onto the surface and diffracted. The X-ray photograph indicates the deformation in the direction of the primary beam from which the stresses at the irradiated place can be determined. 7 references. Ha (9a)

X-ray Stress Measurements on Welded Structures (Beitrag zur röntgenographischen Spannungsmessung an geschweissten Bauwerken) F. Wever & Ad. Rose. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 18, No. 3, 1936, pages 31-33. Measurements with X-rays on fabricated I-beams showed all over the surface high compressive stresses which, however, were not caused by the welding process. They originated in the rolling of the original profiles used to make up the beams and were increased by the straightening process. These stresses are restricted to the surface and penetrate about 0.5 mm. Ha (9a)

Methods of Determination of Radioactivity in Solid, Liquid and Gaseous Substances (Methodos de Determinacao da Radioactividade dos Corpos Solidos, Liquidos e Gazosos) A. Leal. *Revista Brasileira de Chimica,* Vol. 1, Apr. 1936, pages 137-140. Principles and instruments, and application for industrial purposes are described. Ha (9a)

Prevention of Injuries by Radiation in Testing of Materials by Mesothorium and Radium (Die Verhütung von Strahlenschädigungen bei Werkstoffprüfungen mit Mesothor und Radium) W. Friedrich & W. Noethling. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Apr. 11, 1936, pages 437-440. The sources and kinds of serious injuries when testing materials with radioactive substances are explained and preventive means and equipment described. Ha (9a)

Defects in Steel (Fehler im Stahl) R. Scherer & W. Zieler. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80. June 13, 1936, pages 751-754. The principal defects in steel can be due to defects in the melting and casting process, defects in hot and cold working, defects in heat treatment of the finished steel, and defects due to wrong selection and application of tools. These conditions are discussed at some length. 13 references. Ha (9a)

■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

Impact Test Piece with 2 mm. Notch Best for Alloy Steel. Federico Giolitti. *Metal Progress,* Vol. 29, May 1936, pages 71-72. Data presented indicate that a 2 mm. notch is superior to 3 or 5 mm. notches for impact specimens. WLC (9b)

Determination of Strains in a Welded Seam by Means of Photo-elasticity (Sobre la determinacion de tensiones en un cordon de soldadura por la fotoelasticidad) J. Bech Argeles. *Metalurgia y Construccion Mecanica,* Vol. 2, July 1936, page 6. This instalment deals with the determination of strains in a welded seam. 15 references. FRM (9b)

Evaluation of Toughness Under Low and High Speed Loadings. Robert S. Rose. *Metal Progress,* Vol. 30, July 1936, pages 61-62. From work and discussion of this subject the writer presents the conclusions that static or low speed tests are unreliable as indexes for applications under really high speeds, that tests allowing separate evaluation of the several mechanical properties are helpful, and that both static and high speed tests are essential to reveal the true capacity of a material. WLC (9b)

Some Tests of Steel Columns Incased in Concrete. Ambrose H. Stang, Herbert L. Whittemore & Douglas E. Parsons. *Bureau of Standards Journal of Research,* Vol. 16, Mar. 1936, pages 265-287. In coöperation with the Bridge Department of the Port of New York Authority, the National Bureau of Standards tested 4 C steel columns incased in reinforced concrete to determine their strength and stiffness. The steel columns were duplicates of columns TC1 and TC2 reported in Bureau Research Paper RP831. The temperatures in the columns were measured during the aging of the concrete. The readings of telemeters attached to the steel members indicated that no appreciable stress in the steel members was caused by the aging of the concrete. When the columns were loaded, the telemeter stresses were always less than the quasi-stress obtained by dividing the load by the cross-sectional area of the steel members. The concrete, therefore, carried a portion of the load. At the column yield strength, the load on the incased columns was 51% greater than the load on the unincased columns. At the final maximum load the load on the incased columns was 42% greater than the load on the unincased columns. WAT (9b)

Accelerated Service Tests of Pintle Bearings. Ambrose H. Stang & Leroy R. Sweetman. *Bureau of Standards Journal of Research,* Vol. 15, Dec. 1935, pages 591-600. Accelerated service tests of pintle bearings with different combinations of materials for the pintles and cups, different pressures, and different conditions of lubrication were made under conditions similar to those which might obtain in practice as to the line of thrust and angle of swing. The bearings were under water during the tests. The tests were made in connection with the dams of the Tennessee Valley Authority. The results indicated that of the materials tested one must be phosphor bronze to give satisfactory service for pressures as great as 2,000 lbs./in.^{2} Pintles of H-monel, M-monel, and S-monel, gave satisfactory service at this pressure with phosphor-bronze cups. Cups of stainless steel, Cr steel, Cr-Ni steel, malleable cast Fe, and Monel alloys were scored badly after only a few cycles when tested under a pressure of 2000 lbs./in.^{2} Al-bronze cups were worn excessively at a comparatively small number of cycles. Phosphor bronze was the only cup material tested in this investigation which gave satisfactory service with a pressure as great as 2000 lbs./in.^{2} A stainless steel pintle and phosphor-bronze cup provided with grooves for water circulation and tested under a pressure of 4000 lbs./in.^{2} withstood more than 288,000 cycles, the number of cycles expected in 20 years' service. WAT (9b)

Prestressing and Serviceability of Bolted Assemblies (Vorspannung und Dauerhaltbarkeit von Schraubenverbindungen) A. Thum & F. Debus. *Mitteilungen der Materialprüfungsanstalt a.d. Technischen Hochschule Darmstadt,* No. 7, 1936, 72 pages. This is mechanical engineering rather than metallurgy. The bolts chiefly used were the German standards grade of steel known as 38.13 of 0.05% C, 0.47% Mn, 0.075% P, 0.05% S, of 61,500 lbs./in.^{2} tensile, 31% elongation (in 5 diameters), 64% reduction of area. After various degrees of tightening of the bolts they were subjected to repeated impact loading, of varying intensities, one being finally applied under which the bolt would be unbroken after 2 million repetitions of stress, so that S-N curves could be drawn. Tensile endurance tests were made on belts with machined and rolled threads, without showing notable advantage for either. A shaft smaller than the threaded portion, preferably with the shaft cold worked, minimizing of notch effect and stress concentration by proper shape of threads and of the nut, and screwing the assembly up to the proper degree of prestress are all considered important in securing a bolted assembly that is secure against fracture. HWG (9b)

Upper and Lower Yield Point. G. Welter. *Metal Progress,* Vol. 29, May 1936, page 69. Addition to discussion in *Metal Progress,* Vol. 29, Mar. 1936, pages 66-67. WLC (9b)

Effect of Temperature on the Maximum Force in Impact Tests (Temperaturens inflytande på maximikraften vid slagböjningsprov) W. Weibull. *Jernkontorets Annaler,* Vol. 120, Apr. 1936, pages 167-183. The tests were made in an alpha pendulum apparatus with standard Charpy specimens 10 x 10 mm. and with a 2 mm. groove. The specimen rested on quartz supports and the impact pressure was measured by the change in electrical resistance. The expended work was measured by standard methods. 3 C steels (0.10-0.27% C) and 2 Cr-Ni steels (0.33% C, 1.32% Cr, 2.46% Ni; and 0.43% C, 0.66% Cr, 1.05% Ni) were tested at temperatures from + 100° to — 180° C. The maximum breaking impact decreases sharply at temperature intervals characteristic of each specimen. When the fracture is due to slippage the maximum impact pressure increases as the temperature is lowered, but when the temperature is lowered to the point where the slippage resistance equals the cohesive resistance the breaking impact is constant. The appearance of the fracture changes sharply at the same time, being characterized as "brittle fracture" at the low temperatures and "tough fracture" at the high temperatures. The Cr-Ni steels become brittle at — 80° C. or lower; the C steels at — 20° to — 40° C. HCD (9b)

An Abnormal Electrical Conductivity in Powdered Tellurium. C. Hawley Cartwright. *Physical Review,* Vol. 49, Mar. 1936, pages 443-448. It was found that Te powder under a pressure of 1000 kg./cm.^{2} had about 10 times greater specific electrical conductivity than that of a single crystal of Te under the same pressure. Momentarily passing an electrical current through the powder under pressure caused its volume to diminish, but also the electrical conductivity was greatly decreased and, in the cases of pure Te, it became almost the same as that of the massive metal. Under a hydrostatic pressure of 20,000 kg./cm.^{2} massive Te increases its electrical conductivity more than 100 times and the rate of increase rises rapidly with pressure. WAT (9b)

Deep-drawing Test for Aluminum. A. G. C. Gwyer & P. C. Varley. *Metal Progress,* Vol. 29, Mar. 1936, pages 82, 84, 86. See *Metals & Alloys,* Vol. 7, June 1936, page MA 308L/7. WLC (9b)

Accuracy of Dynamic Material Testing Machines (Die Genauigkeit von dynamischen Materialprüfmaschinen) E. Erlinger. *Messtechnik,* Vol. 12, June 1936, pages 109-111. The difference in behavior of static and dynamic testing machines is explained. While the accuracy of static calibration is generally ± 1% of the maximum load, the dynamic accuracy depends on the masses set in motion during the dynamic test, their mutual relation, and on the difference between static and dynamic elasticity modulus. These points are discussed with regard to construction of the machine and measuring technique. Ha (9b)

Testing for Adherence of Galvanized Coatings. B. P. Finkbone. *Journal American Zinc Institute,* Vol. 17, 1936, pages 76-80. In order to show how galvanized sheets will perform in forming operations a proper test should take in the following factors: (1) Severity of forming for a given weight of coating, (2) elongation of material to be expected from the forming to be done, (3) speed of operation, (4) variation in weight of coating. As a supplement to such a test it is very desirable that a standard method of interpretation be established. Such a method could be developed from an examination of numerous test results. It would probably be necessary to base it upon a visual examination of the test samples together with the correlation of certain specific test conditions with those of actual fabricating operations. BHS (9b)

Relationships in Cast-iron Test Results. G. L. Harbach. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 317-344. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 139L/2. CEJ (9b)

Technical Determination of the Elastic Modulus of Metals at Elevated Temperature by a Creep-limit Device according to Dr. Rohn (Ueber eine technische Bestimmung des Elastizitätsmoduls von Metallen bei erhöhter Temperatur mittels Kriechgrenzengerät nach Dr. Rohn) H. Krainer. *Messtechnik,* Vol. 12, June 1936, pages 111-114. The principle of the method is that the elastic shortening of a specimen under load is offset by thermal expansion by automatically increasing the temperature of the specimen electrically if the load is removed. Theory of the method is derived, and the application illustrated by an example. Ha (9b)

■ 9c. Fatigue Testing ■

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

Rapid Fatigue Test. J. W. Cuthbertson. *Metal Progress,* Vol. 29, June 1936, pages 67, 86. See "The Load-Deflection Fatigue Test," *Metals & Alloys,* Vol. 7, June 1936, page MA 309L/2. WLC (9c)

Effect of Continuous Corrosion and Abrasion on the Fatigue of Steel. T. U. Matthew. *Journal, Royal Technical College,* Vol. 3, Jan. 1936, pages 636-660. Details are given of experiments which were conducted on a Wöhler type fatigue testing machine fitted with specially designed auxiliaries giving a continuous abrasive and corrosive effect while the specimens were running under load. A new type of action is described where continuous abrasion and abrasion with corrosion is applied on the loaded specimens and the results obtained are compared with previous results where "surfacing" had been done previous to loading or where continuous corrosion takes place during the test. Continuous abrasion is found to have a serious crack-forming tendency, whereas continuous polishing is found to act as a crack inhibitor in proportion to the fineness of the polishing effect. Continuous abrasion and corrosion acting simultaneously are shown to have a mutually inhibitive effect, due to the reduction of abrasion to polishing by lubricating action of the corrosive field. A new "short time" method of determining the fatigue limit is also described, and the accuracy of method checked by means of a series of tests on a 3.5% Ni steel. JWD (9c)

Endurance Strength of Cast Iron, Malleable Iron and Cast Steel (Ueber die Dauerfestigkeit von Gusseisen, Temperguss und Stahlguss) R. Mailänder. *Technische Mitteilungen Krupp,* Vol. 4, June 1936, pages 59-66. Results of work in this direction are reviewed, tables are given comparing mechanical properties of the 3 materials and the relation between tensile, bending and oscillating stresses and effect of notches discussed. 26 references. Ha (9c)

Are Fractures of Automobile Rear Axles Fatigue Fractures (Sind Brüche von Kraftwagen-Hinterachswellen Dauerbrüche)? M. Ulrich. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Feb. 15, 1936, pages 181-182. Investigation of a great number of fractures of grooved axles and shafts showed conclusively that the fractures are not simple fatigue (endurance) fractures but are due to overstresses produced by the shape of the section of the piece, and that fractures in operation are not caused by torsional stresses. Torsional stresses below the elastic limit very likely start the fracture in the corners of grooves where the peaks of the stresses occur. The effect of the structural nature of the material is discussed. Ha (9c)

Strength of Metals under Combined Alternating Stresses. H. J. Gough. *Iron & Steel Industry,* Vol. 9, Jan. 1936, pages 132-137; Feb. 1936, pages 177-178. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 25R/2. CMS (9c)

Investigation on the Effect of an Addition of Cadmium on the Endurance Limit under Reversed Flexure of Copper Wire (Untersuchung über den Einfluss eines Kadmiumzusatzes auf die Schwingungsfestigkeit von Kupferdraht) W. Engelhardt. *Mitteilungen aus dem Forschungsanstalten des GHH-Konzerns,* Vol. 4, May 1936, pages 144-146. Electrolytic Cu wire and Cd-Cu wire, one drawn to the same tensile strength as electrolytic Cu wire and another drawn with higher tensile strength were compared; the Cd addition was 0.43%.

	tensile strength kg./mm.^{2}	endurance limit under reversed flexure for 50 million alternations kg./mm.^{2}
Electrolytic Cu wire	39.0	9.1
Cd-Cu wire	39.6	11.3
Cd-Cu wire	44.4	12.4

Although the electric conductivity is lower, about 51.8 ohm/mm.^{2} against 57 ohms, the static and dynamic properties are improved by the Cd addition in such manner that the reduction in conductivity is more than offset in many practical applications. Ha (9c)

Dependence of Endurance Strength of Steel on the Frequency of the Load Alternations (Abhängigkeit der Wechselfestigkeit des Stahles von der Lastwechselfrequenz) F. Körber & M. Hempel. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 18, No. 1 1936, pages 15-19. Attention is called to the effect of stress distribution over the section of the specimen when the ratio, endurance strength under alternating load to tensile or bending strength, is determined. Tests on following steels: 11C-.16 Cu; .17C-.48 Cu; .44C-.15 Cu; 0.64C-0.10 Cu; and 3 Cr-Ni steels, showed that the endurance strength for high frequencies (450/sec. in the tests) is from 8-13% higher than for lower frequencies (450/min.) The damping effect of the material is of great influence. Curves show the endurance strength under different conditions. 15 references. Ha (9c)

9e. Spectrography

L. W. STROCK, SECTION EDITOR

Bibliography of Literature on Spectrum Analysis. D. M. Smith. British Non-Ferrous Metals Research Association, London, 1935. Paper, 6¼ x 10 inches, 20 pages. Price 1s. 6d.

This is a supplement to "Metallurgical Analysis by the Spectrograph," previously published as Research Monograph No. 2 of the Association. It includes not only the references cited in the monograph but the others in that field from 1933 to March 1935, making a total of 195 entries. H. W. Gillett (9e) -B-

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10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

The Allotropy of the Chemical Elements and the Results of X-ray Study (Die Allotropie der chemischen Elemente und die Ergebnisse des Röntgenographie) M. C. Neuburger. Ferdinand Enke Verlag, Stuttgart, 1936. Paper, 6¼ x 9½ inches, 106 pages. Price 9.30 RM.

The first question to be asked about a book of this title is "Why was it written?" In answer, it should be stated that while there are various tables and summaries of the crystal structure of the elements, these do not cover all of the various types of experiments that can indicate a change in crystal structure, nor do they critically discuss the evidence in doubtful cases. While it is true that almost no one believes that Al, Cu, Ag and Pd exist in more than one crystal form, it must be admitted that all of these as well as many other elements have been suspected at one time or another of being allotropic, and that there may be justification for a book that summarizes the evidence for and against allotropy in such cases. Mr. Neuburger's treatment of each element is brief but thorough; determinations of the thermal variation of the physical properties are mentioned and in a sentence or two the anomalies and critical points in these properties are discussed. These are followed by references to the X-ray diffraction studies and the conclusions to be drawn from them: the temperature range of stability of each modification and its lattice constants (the latter as given by Neuburger in "Gitterkonstanten für das Jahr 1936, *Zeitschrift für Kristallographie,* Vol. 93, 1936, pages 1-36). Atomic coordinates are not listed; the structures are illustrated in diagrams and are referred to by the various symbols. According to this listing, which is the most recent and most complete that has appeared, there are 23 elements known to have allotropic modifications (Fe, Co, Ni, Rh, Ru, Mn, Cr, W, U, Zr, C, La, Ce, Be, Ca, Tl, Sn, As, P, N, O, S, Se), and there may be allotropes of some 14 others (probably Hf, Th, Ba, Sr, Pr, Nd, Er, and possibly I, Te, Sb, Bi, Ge, Ag and Pd). The book concludes with short chapters on Wever's classification of the alloys of Fe as to the shape of the γ-field; a brief, uncritical summary of studies on orientation relationships resulting from transformations; and a bibliography that contains 1002 references.

Unfortunately the author has taken no pains to make the book convenient for occasional reference—it leaves the reader wishing the book had been condensed into a table. The elements are not arranged alphabetically nor by atomic number, but in groups that must be located via the index or the table of contents. The bibliography is arranged alphabetically by author's name up to entry 921, but is haphazard from 921 to 1002; it is run together in a most annoying manner, without paragraphing or bold faced numbers or letters to assist the reader in finding a given reference. C. S. Barrett (10) -B-

Note on the Tarnishing of Liquid Metals as Studied by X-rays. Hugh O'Neill & G. S. Farnham. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 253-256. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 144L/9. (10)

Further Study of Copper-tin Alloys by X-ray Analysis. E. A. Owen & E. C. Williams. *Journal Institute of Metals,* Vol. 58, Mar. 1936, pages 153-167 (Advance Copy No. 730). The study concerns δ and η phases. The δ region was examined at temperatures below 550° C. and found to be solid solution. The range of solution increases from zero at the eutectoid point, which is at 67.15% Cu and 330° C., to 0.48% by weight at 550° C. The η phase was found to be solid solution, the range of solution at 250° C. extending from 61.68 to 62.10% and at 530° C. from 61.68 to 62.20% Cu by weight. Observations are also recorded which confirm the conclusion that the δ phase transforms to $(\alpha + \eta)$ at approximately 330° C. 11 references. JLG (10)

Alloys of Platinum with Rhodium (Ueber Legierungen des Platins mit Rhodium) W. A. Nemilow & N. M. Woronow. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 226, Feb. 7, 1936, pages 185-191. See *Metals & Alloys,* Vol. 6, June 1935, page MA 247L/9. WB (10)

Alloys of Platinum with Antimony (Ueber Legierungen des Platins mit Antimon) W. A. Nemilow & N. M. Woronow. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 226, Feb. 7, 1936, pages 177-184. See *Metals & Alloys,* Vol. 6, June 1935, page MA 244R/1. WB (10)

X-ray Measurement of the Thermal Expansion of Pure Nickel. E. A. Owen & E. L. Yates. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, Apr. 1936, pages 809-819. The thermal expansion of the crystal lattice of 99.98% Ni was measured over the range from 12° to 600° C. The structure remained face-centered cubic over the whole range; the parameter at 18° C. was found to be 3.5172 A.U. and the density 8.897 g./cc. The maximum value of thermal expansion occurs at 370° C. and is 26×10^{-6}. A considerable irregular change takes place in the region of magnetic transformation. The ferromagnetic change in length per unit length is about 2.4×10^{-4}. An attempt is made to explain generally the occurrence of transformations in alloy systems at certain temperatures by the migration of atoms from point to point in the lattice. Ha (10)

Influence of Various Factors on Graphitization During Solidification of Cast Iron (Influence de divers Facteurs sur la Graphitisation à la Solidification des Fontes) Albert Portevin & Robert Lemoine. *Comptes Rendus,* Vol. 202, Apr. 15, 1936, pages 1343-1345. Studies were made of Ca and Si additions to molten cast Fe and the number of graphite particles/mm.^{2} noted under the microscope. These effects were correlated with the ability of the sample to be chill cast and with changes in physical properties. FHC (10)

Representation of Ternary Systems (Darstellung von Dreistoffsystemen) E. Scheil. *Archiv für das Eisenhüttenwesen,* Vol. 9, May 1936, pages 571-573. To enable the reader to utilize ternary systems more easily a scheme is proposed whereby the transformations in 3 and 4 phase equilibria are indicated by the chemical symbols and arranged in tabular form. Since in ternary ferrous alloys the limits of the austenite and ferrite fields are of especial interest, these limits are projected either onto the base of the solid models or onto one of the sides. SE (10)

A Survey of the Iron-carbon Diagram Near Zero Carbon (Below 1000° C.). J. H. Whiteley. *Iron & Steel Institute,* Advance Copy No. 15, May 1936, 10 pages. A cupric etching method that makes cementite readily apparent in steels containing less than 0.03% C is described. By means of this etching the gradual solution of cementite in α Fe on heating above 550° C. was examined. Results indicated that the solid solubility of C in Fe did not vary between room temperature and 550° C. Above 800° C. the formation of martensite in very low-C steel was observed, thus enabling the location of the line separating the α and $\alpha + \gamma$ field. 12 references.
JLG (10)

Plasticity of Metal Crystals and Its Importance for Properties of Materials (Plastizität von Metallkristallen und ihre Bedeutung für die Werkstoffeigenschaften) G. Wassermann. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Mar. 7, 1936, pages 283-287. In the deformation of metals, 2 crystallographic processes are effected: translation and mechanical twin formation. These processes are investigated for different kinds of crystals and it is shown that the dependence of the elastic modulus on direction, the mechanical strength and other properties can be explained and, in some cases, even calculated from monocrystal data and structural examination of a metal. The application of these theories to practical problems, in particular for working processes of Mg alloys, is illustrated.
Ha (10)

Austenitic Grain-Size in Cast Iron. D. W. Murphy & W. P. Wood. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 75-95. A network developed by heating cast Fe to 1560°-1650° F. shows varying grain size for irons of essentially the same composition but varying ultimate strength. As-cast strength increases with grain size. Study of the hardenability of these irons shows that property to increase with grain size. Further study of this phenomenon is suggested as an aid in control of cast Fe and knowledge of its heat treatment possibilities. In discussion some doubt is expressed as to the reality of the network or cellular structure representing austenite grain size.
WLC (10)

Iron-tantalum Binary System (Zur Kenntnis des Zweistoffsystems Eisen-Tantal) Werner Jellinghaus. *Technische Mitteilungen Krupp,* Vol. 3, Nov. 1935, pages 214-215. See *Metals & Alloys,* Vol. 7, May 1936, page MA 254L/1.
Ha (10)

Reactions in the Solid State (Reaktionen im festen Zustande) W. Jander. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Apr. 25, 1936, pages 506-510. Reactions in solid state take place in case hardening of Fe, hardening of Al alloys, ore-roasting processes, manufacture of cement and ceramic products. They are explained in detail and micrographs of the structures at various stages shown.
Ha (10)

On the Preparation of Iron and Steel Specimens for Microscopic Investigations. Francis F. Lucas. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 1-25. Describes methods and materials for preparation of specimens. A flotation apparatus for preparation of abrasives is described and particle size analysis of MgO used is given.
WLC (10)

Theory of Metallic Crystal Aggregates. Charles G. Maier. *Metals Technology,* Apr. 1936, *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 701, 50 pages. Density changes in Cu cold worked by rolling, drawing, or torsion were determined. Similar measurements on ingot Fe were supplemented by coercive-force determinations. Variations of density of Fe were similar in kind to those observed in cold working Cu, including a minimum in density in drawing. It is concluded that metallic crystal aggregates, typical of annealed rolled metals, show density changes that are functional, rather than random, with increasing cold work, but the original density in the annealed state may be somewhat random, as affected by mosaic block structure. Lattice distortion is attributed to the result of changes occurring in deformation. Semi-quantitative explanation of observed behavior requires postulation of the existence in the metal of atoms having higher heat and energy content than the lattice, which have been treated as a new phase differing from the Beilby "amorphous cement" in being a denser adsorbed film, and having little to do with work hardening except to explain the existence at inter-crystalline boundaries of a potential barrier partly permeable at ordinary temperatures to atomic dislocations, thus conforming with and complementing the Taylor dislocation theory of strain hardening. 37 references.
JLG (10)

Influence of Metals of the Iron Group on the Aging of Pure Aluminum Alloys. W. Koch & F. W. Nothing. *Metal Industry,* London, Vol. 47, Dec. 6, 1935, pages 561-562. See *Metals & Alloys,* Vol. 7, May 1936, page MA 254L/5.
HBG (10)

The Atomic Scattering Factors of Aluminium, Nickel and Copper for Cu Kα Radiation and Their Relation to the Theory of X-ray Dispersion. G. W. Brindley. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, Apr. 1936, pages 778-790. The scattering factors of Ni and Cu were restandardized in terms of reflection from Al powder. Measurement methods are described. 17 references.
Ha (10)

Microstructure of Nickel and High Nickel-Chromium-Iron Alloys. *Metal Progress,* Vol. 29, Mar. 1936, opposite page 56. 6 micrographs from Laboratory of International Nickel Co.
WLC (10)

The X-Ray Powder Photography of Alloys. A. J. Bradley. *Metal Industry,* London, Vol. 47, Dec. 20, 1935, pages 611-613, 619. Condensed version of a lecture. After reviewing the work of earlier investigators and showing that today many of the most common elements are still incompletely investigated by standard metallurgical methods, the author discussed the phase diagram of the Ag-Cd system. Other systems discussed were the Cu-Al system, the Fe-Al alloys and the Cu-Mn-Al alloys. The discussion of the paper is appended.
HBG (10)

Oxalic Acid as an Electrolytic Etching Reagent for Stainless Steels. George A. Ellinger. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 26-45. Advantages of described method of etching are given as, (1) it reveals both carbides and grain boundaries, (2) it is rapid and not dangerous, (3) specimens do not stain, (4) specimens are suitable for high magnification study and (5) application to welded joints gives good results. Specimen is made the anode, Pt cathode, in 10% water solution of oxalic acid using 6 volts.
WLC (10)

11. PROPERTIES OF METALS AND ALLOYS

Condition of Electrolytically Deposited Metals (Ueber den Zustand elektrolytisch abgeschiedener Metalle). G. Tammann & H. Jaacks. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 227, May 28, 1936, pages 249-260. Grain size of Cu deposit varies, being smaller near cathode surface and increasing toward anode. In contrast with 77% cold drawn Cu which shows visible recrystallization at 250° C. and quite evident at 600° C. the deposited Cu shows grain growth at 300° C. and recrystallization starting at 600° C. Table is given showing progress of grain growth and recrystallization for deposited Cu in 3 zones of the deposit where grains originally are small, intermediate and large and after recrystallization grains are uniformly .2 mm. in size for all 3 zones. Structure and behavior on heating of Fe, Zn and Ni deposits are reviewed. Lattice distortion in electrolytically deposited metals is compared with lattice distortion of hardened state of metals since distortion in both disappears on heating. Cu, Ni, Fe, Zn, Cr in natural deposited state are hard and hardness has been attributed to dissolved H_2 but table shows that it cannot be the cause of hardness when compared with annealed and rolled material and it is noted that with higher bath temperatures Fe is softer than usual. Curve is shown for hardness of Ni and H_2 content versus pH where hardness and H_2 content are directly opposed. Data are cited as furnished by the literature which indicate lack of correspondence between indentation hardness and H_2 content. Solution velocity tests in $3N$ H_2SO_4 were made with electrolytic Fe and Zn after heating from 20°-570° C. (20°-415° C. for Zn) for 1¼ hr. in H_2 atmosphere. It was found that electrolytic Fe at the start dissolves more slowly than re-melted, rolled electrolytic Fe but after 150 minutes of test the corrosion velocity is greater for the electrolytic Fe. Since the H_2 can be removed from the deposited metals by heating under vacuum and no difference in hardness and solution velocity obtained thereby it is considered that the deposited metals are under strain as are metals in hardened state. This is tied up with temperature of deposition and presence or absence of chemical and cooncentration-polarization.
WB (11)

Engineering Alloys (Names, Properties, Uses). N. E. Woldman & A. J. Dornblatt. American Society for Metals, Cleveland, 1936. Cloth, 6 x 9¼ inches, 622 pages. Price $10.00.

This is a sort of "Campbell's List" enlarged to some 8200 entries. It gives the trade names of steels and other alloys, who makes them, and states something as to the properties claimed by the maker and the uses for which he advocates them. It is emphasized that only the maker's statements, uncorroborated and unqualified, are given. If one knows the trade name or the maker's name, the index is so arranged that the entry can be found, but if one wants to find out if an alloy of a given composition is on the market, the index leads to the answer only in the case of heat-resistant and corrosion resistant alloy steels. Unless it is hidden away under some sub-heading in the index, which does not indicate its presence, no cadmium-base bearing alloy is listed, nor can we find reference to the Ford crankshaft alloy. The title might more accurately be "Trade-named" than "Engineering." Nevertheless, there is a surprising lot of information that one sometimes wants, and when he wants it, he always wants it in a hurry. That the information is not complete is only to be expected and one is thankful for what there is. Once in a while the gaps are irritating, as it is often stated that some alloy steel contains "C, Fe and alloy," which means that the maker didn't tell, while in others the maker's information is incompletely quoted, e.g., no P is listed in the Cor-ten analysis, though there are plenty of publications which comment on its presence.

On the whole, the compilation is worthwhile and while its failure to tell the whole story will often irritate the reader, he should be less irritated than by the entire lack of information he would often have to contend with without it.

The price seems high, but such a book is costly to print.

H. W. Gillett (11) -B-

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Copper-Lead Antifriction Alloys (Alliages Antifrictions Cuivre-Plomb). A. Ricard. *Usine,* Vol. 45, Jan. 2, 1936, page 37. The properties of Cu-Sn-Pb alloys are explained on the basis of the Cu corner of the ternary diagram. Tensile strength and resistance to repeated shocks decrease with increasing Pb content from 0.25 to 25% and decreasing Sn content from 10 to 0%. Alloys of Cu-Pb with less than 2.5% Pb are unsuitable for bearings but are used for oil rings, packing rings, pistons and air pumps. 2.5% Pb does not sufficiently improve the friction properties but does improve the machinability. 10% Pb is necessary to obtain the plasticity desired in polishing and peening the bearing surfaces. Sn rich bronzes with 5-8% Sn are less sensitive to high temperatures and therefore suitable for bushings under heavy load. The wear resistance is little modified from 12 to 25% Pb, but the mechanical properties deteriorate beginning from 15% Pb. The Pb alloys can be machined with speeds higher than 100 m./sec.; broaching is a particularly suitable method.
Ha (11a)

Magnesium and its Ultra Light Alloys (La Magnésium et les Alliages Ultra-Légers). Paul Bastien. *La Technique Moderne,* Vol. 27, Feb. 1, 1936, pages 65-71. Discusses the foundry properties of ultra light alloys as to their castability, shrinkage and common defects. The work of W. Schmidt on the hot working of ultra light Mg alloys is summarized. Machining of these alloys is very easy and is made at highest machining speeds with tools having a cutting angle of 12°. The corrosion resistance of Mg base alloys is discussed, those having the best resistance being those containing Mn and Mn + Al. The most common process for their surface treatment consists in immersing the alloys for some hours in alkaline chromate and dichromate mixtures heated to 90° C. Another process is by coating with Se. Metallization by the Schoop process and electroplating have not yet been successful.
FR (11a)

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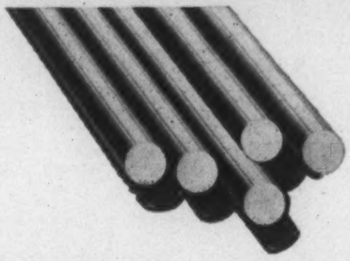

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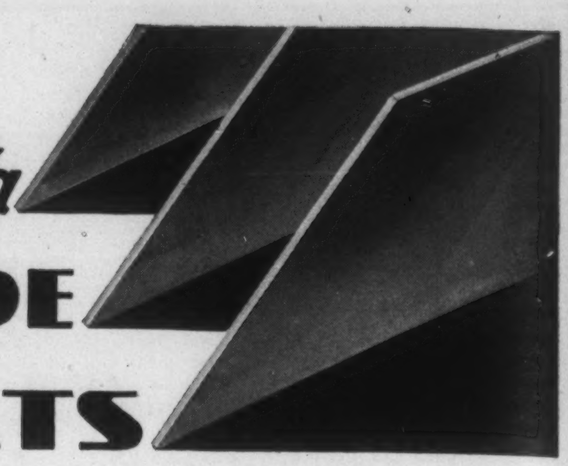

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Zinc-Indium Alloy System. CURTIS L. WILSON & ETTORE A. PERETTI. *Industrial & Engineering Chemistry,* Vol. 28, Feb. 1936, pages 204-205. Based on the preparation and examination of 30 alloys of Zn and In, the equilibrium diagram was constructed from the combined cooling curves. 4 photomicrographs are shown. The alloys become softer as the In content is increased; the 54% In alloy can be scratched with the finger nail. All of the alloys have a silvery white color. MEH (11a)

Aluminum-copper-nickel Alloys of High Tensile Strength; K. Monel (Cupro-nickels à l'aluminium à haute rèsistance; Monel K). W. A. MUDGE & P. D. MERICA. *Métaux,* Vol. 10, Dec. 1935, pages 336-340. Extracted from two publications: "Aluminum-copper-nickel Alloys of High Tensile Strength subject to Heat Treatment," *Metals Technology,* Apr. 1935 (See *Metals & Alloys,* Vol. 6, Aug. 1935, page MA 333L/4) and "Engineering Properties of K Monel," Bulletin T 9, International Nickel Company. GTM (11a)

Rolling Technique and Properties of Lead Bearing Alpha Brasses. P. I. GRADUSOV. *Tzvetnuie Metallui,* June 1935, pages 58-65. (In Russian). A description of melting, casting, cold rolling technique, and properties of brasses containing 2.1 and 2.6% Pb. BND (11a)

White Bearing Metals with High Tin Content (Hochzinnhaltige Lager-Weissmetalle). FRHR. v. GÖLER & H. PFISTER. *Metallwirtschaft,* Vol. 15, Apr. 10, 1936, pages 342-348; Apr. 17, 1936, pages 365-368. Sn bearing metals containing 3-10% Cu and 2-12% Sb were prepared from high purity materials and their mechanical properties determined. This is supplemented by the information already in the literature. Within the solid solution range from 0-9%, Sb increases the resistance to deformation and the endurance limit, beyond this range it does not improve these properties and causes embrittlement. Cu has the same effect to a smaller extent. Of the common impurities Pb is the most objectionable due to its eutectic with Sn and Sb melting at 180°. Ni and Cd have some value as hardening additions. The change in mechanical properties with temperature is about the same for all alloys of this type. GD (11a)

Plasticity of Bismuth Crystals. H. J. GOUGH & H. L. COX. *Nature,* Vol. 137, Apr. 25, 1936, page 701. Alternating torsional stresses having previously failed to produce slip in Bi crystals, reversed direct stress (tension and compression) was tried on a single crystal. Again slip lines were absent (except near the fracture) and deformation was by twinning. However, when the same crystal was subjected to static compression along the same axis, it deformed by slip rather than by twinning. CSB (11a)

Working of Lead (Le travail du Plomb) J. MAHUL. *Métaux,* Vol. 10, Dec. 1935, pages 371-390. Working, welding and uses of Pb are generally discussed. GTM (11a)

Working of Monel Metal (Le travail du metal Monel) J. PICARD. *Métaux,* Vol. 10, Dec. 1935, pages 324-335. Welding, fabricating, cleaning and general treatments are discussed. GTM (11a)

11b. Ferrous

V. V. KENDALL, SECTION EDITOR

Low Alloy, High Yield Strength Structural Steel. An Extended Abstract. *Metals & Alloys,* Vol. 7, Mar. 1936, pages 77-84. Discusses findings of recent papers on high yield strength structural steels and their applications. Properties and compositions are tabulated for 32 steels in this classification. 5 references. WLC (11b)

The Lincoln-Zephyr Cast Alloy Pistons. Edwin F. Cone. *Metals & Alloys,* Vol. 7, Apr. 1936, pages 85-87. Electric furnace melted alloy steel castings used for piston castings in Lincoln-Zephyr have the following composition: C 1.35-1.70, Mn 0.60-1.00, Si 0.90-1.30, S 0.08 max., P 0.10 max., Cu 2.50-3.00, Cr 0.15-0.20. Castings are normalized from 1650° F., drawn from 1400° F. and show elastic limit 70,000 lbs./in.^{2}, tensile strength 90,000 lbs./in.^{2} elongation 5.0% in 2 in. and Brinell 207-241. WLC (11b)

Deep Drawing Properties of Harder Carbon Steel Sheet (Tiefziehfähigkeit von härteren unlegierten Stahlblechen) F. Eisenkolb. *Archiv für das Eisenhüttenwesen,* Vol. 9, May 1936, pages 575-578. From Erichsen and tensile tests of C steel annealed sheet, 1 mm. thick, relationships were drawn between tensile strength, elongation, and Erichsen values. The drawability decreased with the hardness. Sheets of tensile strength up to 80 kg./mm.^{2} still showed good drawability. SE (11b)

A Study of the Influence of Varying Degrees of Cold-rolling and Annealing Temperatures on the Properties of Mild Steel Sheets. Part I.—The Influence of Cold-rolling and Subsequent Annealing Temperatures on the Erichsen Values and Crystal Structure of Thin Mild Steel Sheets. C. A. Edwards, D. L. Phillips & W. H. E. Gullick. **Part II.—The Effects of Varying Degrees of Cold Rolling and Annealing Temperatures on the Properties of Motor-car Body Sheets.** C. A. Edwards, D. L. Phillips & C. R. Pipe. *Iron & Steel Institute,* Advance Copy No. 6, May 1936, 67 pages. For work described in Part I two classes of tin-plate steel were used, one relatively low in P and S and the other relatively high. For each steel one set of experiments was made on sheet that had been annealed below 900° C. prior to cold rolling, and the other on which the preliminary annealing temperature was above 950° C. In this way it was possible to examine the effects of chemical composition and initial grain size on the critical degree of cold rolling that produces coarse crystallization on subsequent annealing. With heavy cold rolling complete recrystallization occurred on annealing at temperatures as low as 750° C. irrespective of the original grain size. Under such conditions of heavy cold rolling and low-temperature annealing better Erichsen values were produced than by present-day commercial methods, which consist in hot rolling almost to the final gage and annealing in batches at temperatures below 900° C. Part II is an extension of the work done in Part I to determine the influence of cold rolling and annealing on the tensile properties, hardness and Erichsen values of mild steel sheets used in motor-car construction. This represents a preliminary attempt to correlate the effects of cold rolling and annealing, the tensile properties, and crystal structure with the Erichsen values, and further to ascertain whether the tensile properties obtained after heavy cold rolling and low-temperature annealing approach those obtained by full annealing. The evidence seems to indicate clearly that, when complete recrystallization occurs with low-temperature annealing after heavy cold rolling, the tensile properties show that the drawing qualities should be about the same as those obtained by annealing at, say, 950° C. It was not possible to prove by actual drawing operations that this was the case. JLG (11b)

Small Plastic Deformations in Strip Steel. Directional Properties, Caused by These, Detected by X-Ray Diffraction. Norman P. Goss. *Metals & Alloys,* Vol. 7, May 1936, pages 131-134. Study of slight plastic deformation, 0-15%, showing that the preferred orientation developed by such deformation can be detected. Hot rolling develops preferred orientation which must be allowed for in subsequent cold work. Small degrees of cold work on heat treated metals only fragment the crystals. Preferred orientation is developed in different directions in hot and cold worked wires. WLC (11b)

Chromium and Manganese in Structural and Stainless. Augustus B. Kinzel. *Metal Progress,* Vol. 29, Mar. 1936, pages 46-51, 74. Low Cr-Mn steels have relatively high ductility with increasing tensile strength up to 100,000 lbs/in.^{2} but beyond this point the ductility-strength ratio falls off sharply and the composition is said to be "unbalanced." In sections up to 1.25" and range of strength 70-95,000 lbs./in.^{2} with C 0.10-0.20% steels of 1.25% Mn, 0.5% Cr, and 1.0% Cr, 0.50% Mn are balanced in normalized condition. In a rolled state both are unbalanced but use of 0.75% Si balances the compositions. Discusses the properties of 18 Cr-8 Mn steels as being less susceptible to intergranular corrosion after welding than 18-8 Cr-Ni steel. This composition is about 60% austenitic and 40% ferritic giving the advantages of formability and easy machining of these two constituents. WLC (11b)

Phosphorus as an Alloying Element in Low Carbon, Low Alloy Steels. C. H. Lorig & D. E. Krause. *Metals & Alloys,* Vol. 7, Jan. 1936, pages 9-13; Feb. 1936, pages 51-56; Mar. 1936, pages 69-73. Study is reported of static and impact properties of steels C 0.06%-0.26%, P up to 0.6% with Al treatment for fine grain, with additions of M, Cr, Zr, V, Ti, Ni, Cu and Si singly. Results show satisfactory static ductility even above 0.3% P but at that point impact brittleness is impaired. C and Si additions favor brittleness, Cr definitely and Ni, Cu and Mo less definitely tend toward impact toughness in P steels. In Al treated steel effect of Ti or Zr may be helpful but not so markedly as Cr. Resistance to atmospheric corrosion is improved with P above usual limits in plain P, Ni-P and Cu-P steels. 7 references. WLC (11b)

High-Quality Steels. H. H. Burton. *Times* [*London*] *Trade & Engineering,* Vol. 38, Apr. 1936, pages VI. IX. Outlines development of steel-making processes; melting processes used for making alloy steels; composition and applications of some of the alloy steels made in Sheffield, England; heat treatment; and metallurgical control. MS (11b)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

The Behaviour of Five Cast Irons in Relation to Creep and Growth at Elevated Temperatures. H. J. Tapsell, M. L. Becker & C. G. Conway. *Iron & Steel Institute,* Advance Copy No. 14, May 1936, 27 pages. Creep and growth characteristics of ordinary cast Fe, Ni-Cr Fe, Silal, Nicrosilal, and Niresist were studied between 700° and 1000° F. Effects of prolonged heating on microstructures were also studied. A few comparative creep and growth tests were made on Silal, Nicrosilal and Niresist at 850° C. Creep and growth characteristics of austenitic Nicrosilal at 840° F. and 1000° F. are very little different from ordinary Fe in the as-cast condition. The poor properties of this Fe are probably due to instability of austenite at these temperatures. Good resistance to creep and growth at the 2 temperatures was shown by Niresist, which is also austenitic. It possessed better resistance to growth at 1000° F. than at 840° F. At 850° C. Nicrosilal was superior to both Silal and Niresist. Heating below critical temperature improved growth properties of ordinary and Ni-Cr Fe. JLG (12)

Properties of Rail Steel at Arctic Temperatures. H. B. Wishart & W. D. Boone. *Metal Progress,* Vol. 29, Jan. 1936, pages 61-62. Graphical presentation of data on tensile strength, Brinell hardness, fatigue limit (notched and unnotched), reduction of area, elongation and unnotched Izod of rail steel for the temperature range — 40° to + 80° F. Decreased strength and toughness accompany lower temperatures. WLC (12)

Weakening of Metal by Molten Solder. G. Wesley Austin. *Metal Progress,* Vol. 29, Mar. 1936, pages 64, 90. See "The Effect of Molten Solder on Some Stressed Materials," *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 33R/4. WLC (12)

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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

Protection of Underground Oil Pipe-Lines. *Synthetic & Applied Finishes,* Vol. 6, Feb. 1936, page 274. A discussion of methods for anti-corrosive protection of pipe-lines in the Russian oil fields is presented. The efficiency of the various methods are reported to have been tested by exposure to H_2SO_4, HCl, NH_3, NaOH, NaCl, H_2SO_3, H_3PO_4, fresh water and sea-water. Efficient protection was achieved not only with bitumen paints but with wrapping materials previously impregnated with bitumen. 4 feasible processes for applying the protective coatings to the tubes were developed: (1) Steel tubes are cleansed, immersed inside and out in primer, dried, brushed with bitumen solution thickened with talc, dried, treated with third coat, dried and patched. (2) Tubes are primed, coated once with varnish, wrapped in wax paper and treated with third coat. (3) Pipes are primed inside and out then bunged at the ends, treated on the job externally with thickened bitumen, cooled, treated with unthickened bitumen, wrapped with wax paper and brushed with cold bitumen. Pits are filled with china clay. (4) For salt water exposure pipes are treated as in (3) except that bitumen is thickened with cement instead of talc, and wax paper is replaced with bitumen-impregnated cloth. FPP (13)

The Scaling of Mild Steel in Sulphur-free and Sulphur-containing Furnace Atmospheres. Institution Gas Research Fellowship Report: 1934-35. H. C. Millett & John W. Cobb. *Institution of Gas Engineers, Communication* No. 127, 73 pages; *Gas World,* Vol. 103, Nov. 16, 1935, Industrial Gas Supplement, pages 7-10; Dec. 1935, page 543; *Gas Journal,* Vol. 212, Nov. 13, 1935, pages 503-505; Dec. 4, 1935, page 695; *Engineering,* Vol. 140, Nov. 22, 1935, pages 567-568. Scaling in N was negligible, was evident in CO_2, and definitely more pronounced in steam. Scaling in an atmosphere analyzing steam 2%, CO_2 18% and N 80%, representing the products of combustion of dry, high-temperature coke, was 0.0043 g./cm.^{2} when exposed 1 hour at 1000°. In CO_2 10%, steam 10%, and N 80%, representing combustion gases from coal, producer gas or fuel oil, scaling was twice as great. To render the above nonscaling required 29% H, 95% CO or 21% CH_4. Products from coal gas gave 0.0120 g. scale/cm.^{2} C particles had no appreciable anti-scaling value. Addition of O increased scaling; 2% O_2 added to above, increased scaling 8 times. Increase of O increased scaling up to a certain point, beyond which further increases had no effect; this concentration increases with temperature. At 1000°, 0.1% SO_2 in a neutral furnace atmosphere gave the same increase in scaling as 1% free O_2. When O_2 was 2½-3% the influence of added SO_2 was lost. Oxides of N had little effect. There is a certain critical furnace gas velocity below which the scaling decreases rapidly with the gas velocity. Scaling increases rapidly with temperature. As the period of exposure is increased, scaling increases but at a rapidly diminishing rate. Increasing temperatures produce increasing scaling. LFM + AHE (13)

Corrosion Below Discontinuous Oxide Coatings, with Special Reference to Magnesium. K. G. Lewis & U. R. Evans. *Journal Institute of Metals,* Vol. 57, No. 2, 1935, pages 231-252. Includes discussion. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 417L/4. (13)

Organic Inhibitors of Corrosion—Aliphatic Amines. Charles A. Mann, Byron E. Lauer & Clifford T. Hultin. *Industrial & Engineering Chemistry,* Vol. 28, Feb. 1936, pages 159-163. The blanketing or protective layer of the aliphatic amines is formed by adsorption of inhibitor ions on the metal surface and through the N atom. Long straight-chain aliphatic diamines and triamines are excellent acid-corrosion inhibitors. Stereochemical structure of these compounds determines their effectiveness as corrosion inhibitors. The longer the hydrocarbon chains and the greater the number up to 3 attached to the N atom, the greater is the effectiveness of the inhibitor and the less inhibitor required. 32 references. MEH (13)

Some Recent Investigations on the Corrosion of Tin. D. J. Macnaughtan & E. S. Hedges. *International Tin Research & Development Council, Technical Publication,* Series A, No. 34, 1936, 13 pages. Sn assumes a thin oxide film in air, but the film is not protective. Oxygen favors solution of Sn in Na_2CO_3 or NaOH solutions; without O_2, corrosion is practically nil. The oxides of Sn are soluble in both acids and alkalis. Differential aeration and hydrogen depolarization are therefore important. In many food stuffs, Sn is anodic to Fe. This occurs when the dissolved Sn forms stable complexes with the solvent, after the oxide film has dissolved. The base steel in Sn plate has an effect on the rate of reversal of the potential of the couple, from initial cathodicity of the Sn to its final anodicity. Some steels corrode faster than others. Cracks in the alloy layer, and pores in the Sn coating of course favor corrosion. References are given to 11 original papers on which this summary is based. HWG (13)

Cylinder Wear, Where and Why. S. W. Sparrow & T. A. Scherger. *S. A. E. Journal,* Vol. 38, Apr. 1936, pages 117-125. Wear is greatest where lubrication is at minimum coupled with high temperature and dirt. Numerous graphs are shown of wear of cylinder versus distance from top of cylinder bore which indicate zone of greatest wear for a variety of conditions. WB (13)

Cylinder Wear in Diesel Engines. G. D. Voerlage & B. J. J. Gravesteyn. *S. A. E. Journal,* Vol. 38, May 1936, pages 197-199. Wear is determined by ash content of oil dripping from cylinder in test operation. Necessity for clean air for engine operation is shown in test when .005% quartz dust added gave wear increase of 600%. WB (13)

Oxidation of Aluminum and Its Alloys by Gases and Liquids. V. S. Zorin. *Legkie Metallui,* Vol. 4, Oct. 1935, pages 12-21. In Russian. Heating Al alloys in air at 550° C. slightly increases their resistance to corrosion. HWR (13)

Cylinder Wear in Gasoline Engines. C. G. Williams. *S. A. E. Journal,* Vol. 38, May 1936, pages 191-196. Attention is called to corrosion-wear when running cold due to condensation of moisture in combustion products on cylinder wall. WB (13)

Anionic Iron (Ueber anionisches Eisen) R. Scholder. *Angewandte Chemie,* Vol. 49, Apr. 18, 1936, pages 255-259. The chemical and electrochemical behavior of Fe and in particular the processes taking place in corrosion of Fe are briefly explained and new tests described to elucidate the nature of passive (anionic) Fe. The corrosion of Fe in strong lyes and its dissolution in hot, strong lyes is due to the base potential of Fe and formation of complex Fe^{II}-hydroxyanions. The production of ferrates and ferrites from the latter is described. By oxidation of ferrate solutions well crystallized, colorless hydroxyferrites could be produced. 23 references. Ha (13)

Wear of Gray Cast Iron as Dependent on Cooling Conditions (El degaste de la fundicion gris a traves de las condiciones de enfriamiento) J. Navarro Alcacer. *Anales de la Sociedad Espanola de Fisica y Quimica,* Vol. 34, Mar. 1936, pages 383-392. The purpose of this investigation was to determine the resistance to wear by sliding of common gray cast Fe. By changing only the rate of cooling, different structures were obtained containing varying amounts of graphite. An Amsler machine was used to test the wear. The resistance to wear does not depend on the amount of graphite present. The optimum resistance was obtained when the graphite appeared as long and uniform lamellae. The author has determined qualitatively the average length of these lamellae. FRM (13)

Metallic Wear. H. W. Brownsdon. *Engineer,* Vol. 161, Mar. 20, 1936, pages 321-322; *Engineering,* Vol. 141, Mar. 20, 1936, pages 310-312. Abstract of paper read before the Institute of Metals. See *Metals & Alloys,* Vol. 7, May 1936, page MA 263L/3. VSP (13)

Soviet-Russian Research in the Field of Corrosion and Prevention of Corrosion (Die sovjetrussischen Forschungsarbeiten auf dem Gebiete der Korrosion und Korrosionsverhütung) M. v. Pohl. *Korrosion & Metallschutz,* Vol. 12, Apr. 1936, pages 89-94. The work done and started during 1930-1935 is reviewed and enumerated by titles, and a list of 104 publications added. Ha (13)

Effect of Concentrated Sodium Hydroxide on Boiler Steel Under Tension. A. S. Perry. *Transactions American Society of Mechanical Engineers,* Vol. 58, Apr. 1936, pages 211-216. The results of a study are reported to develop failures in boiler plates under tension and in contact with high concentrations of NaOH causing caustic embrittlement. It could be concluded that whereas the stresses in the fabricated unit and the concentration of caustic in solution may be primary causes of caustic embrittlement, other factors contributing to metal stress may also have an important share, in particular riveting pressures and purity and uniformity of rivet and plate metal. The presence of both intercrystalline and transcrystalline cracks was established but the former are not always necessarily associated with caustic attack. Ha (13)

Experiments on the Erosion of Materials by Cavitation (Versuche über die Werkstoffanfressung durch Kavitation) H. Schröter. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Apr. 18, 1936, pages 479-480. The experiments were made on large hydraulic turbines and showed clearly that mechanical impact in the cavitation process can destroy even very hard metals in a short time. The surface quality and velocity of the water are of determining effect. Addition of Al to bronzes produces a highly resistant material which is equal to the best alloy steels. Ha (13)

Influence of Nitrogen on the Wear-Corrosion and Fatigue Fracture of Gliding Steel Parts (Mitwirkung des Luftstickstoffs beim Fressen aufeinander gleitender Stahlteile und beim Dauerbruch) H. Schottky & H. Hiltenkamp. *Stahl und Eisen,* Vol. 56, Apr. 9, 1936, pages 444-446. Severe local friction of steel parts which cause corrosion results in surface nitrogenization of the steel, as can be shown metallographically and chemically. The nitrogenization tends to increase the embrittlement of the cold worked surface, starting cracks which lead to fatigue fracture. SE (13)

Composition and Use of Lead-Base Bearing Metals (Herstellung und Verwendung von Bleilagermetallen) R. Schmidt. *Stahl und Eisen,* Vol. 56, Feb. 20, 1936, pages 228-231. The properties of commercial Pb bearing metals and the results of hardening Pb with alkali and alkaline earth metals are discussed. "Union" bearing metal with 98% Pb, 1.5% Mg, and 0.2% Ca is described. SE (13)

Determination of the Oxidation Losses in Rolling Mill Furnaces. Part II (Versuche über den Abbrand in Walzwerksöfen (II Teil)) F. Strähuber. *Stahl und Eisen,* Vol. 56, Jan. 30, 1936, pages 108-113. The type of surface seemed to have little effect; as cast and turned ingots gave the same oxidation losses. More oxidation occurred in highly oxidizing than in reducing atmospheres; doubling the time in furnace increased the oxidation losses 1.4 times; raising the temperature from 1300° to 1400° C. increased the losses 1.7 times. SE (13)

Corrosion of Precipitation-hardening Aluminum and Magnesium Alloys (Die Korrosion aushärtbarer Aluminium- und Magnesiumlegierungen) E. Söhnchen. *Korrosion und Metallschutz,* Vol. 12, Mar. 1936, pages 41-46. Numerous investigations of the relations between heat treatment and corrosion show that in the precipitation range, corrosion can be less, equal to, or stronger than in the quenched, homogenized state and curves are given for Al, Mg and Mg-Mn alloys. The application to technical improvements in corrosion resistance by heat treatment is described. 11 references. Ha (13)

Sheath Corrosion at Bond Straps Prevented. Edgar F. Wolf. *Electrical World,* Vol. 106, Feb. 29, 1936, pages 37-38, 85. Presence of alkaline moisture in cement fireproofing forms a short-circuited cell when Cu bonds are soldered to the Pb cable sheath and the Pb may be destroyed. Keeping the bond strap out of contact with the fireproofing and providing an insulating coating for the Pb of primary cables are preventive measures which have been found effective in laboratories and in practice. The use of certain types of fireproofing instead of Portland cement gives a slower rate of corrosion. CBJ (13)

Corrosion of Metallic Materials in the Operation of Water Works (Korrosion der metallischen Werkstoffe im Betriebe der Wasserwerke) G. Wiegand. *Werkstoffe & Korrosion,* Vol. 11, Apr. 25, 1936, pages 20-21. Metallic materials and the attacks they are subjected to are discussed and exemplified by data in the operation of the municipal water works of Berlin. Conduits for the pure water are usually of cast Fe or steel, water meters of brass, filtering devices of Cu, earthenware or glass. Cu used in aeration and de-ironing plants was soon transformed into cupric sulphide; a coat of bitumen is applied to prevent it or, better, Al is used instead of Cu. Phosphor bronze in filtration plants instead of Cu stops corrosion losses. Corrosion in pipe lines is due to chemical effects of the soil or stray currents of electric systems. Bitumen paints largely eliminate corrosion on these lines. Sometimes incrustations occur on the inner wall of pipes which can reduce the flow of water considerably. This is removed by scraping. Ha (13)

Corrosion in the Soil of Cast Iron Water Pipes (Bodenkorrosion Gusseiserner Wasserleitungen) C. M. Wichers. *Korrosion & Metallschutz,* Vol. 12, Apr. 1936, pages 81-85. Graphitization of cast Fe pipes occurs very frequently and leads to fracture. Thorough investigation of the conditions of the soil surrounding the pipes showed the importance of the pH value, porosity, presence of sulphates and carbonates. A certain type of bacteria reduces sulphates to H_2S which is dangerous to cast Fe as it forms Fe sulphide and leaves C behind. A surrounding of dense, alkaline reacting material is the best protection, a mixture of loam or clay with addition of lime being recommended. Ha (13)

Corrosion of Tin and Tinned Materials with the Formation of Black Spots (Ueber die Korrosion von Zinn und Verzinnten Materialien unter Bildung schwarzer Flecken) S. Brennert. *Korrosion & Metallschutz,* Vol. 12, Mar. 1936, pages 46-49. See "Black Spots on Tin and Tinned Ware," *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 512R/2. Ha (13)

Electric Pipe-line Drainage. G. I. Rhodes. *Electric Journal,* Vol. 33, Feb. 1936, pages 91-96. Elements of cathodic protection are reviewed. An 80-mile commercial installation is described together with a cost analysis and a discussion of results obtained. See also *Metals & Alloys,* Vol. 7, May 1936, page MA 261R/5. CBJ (13)

Corrosion of Iron and Steel. R. Hadfield & S. A. Main. *Iron & Coal Trades Review,* Vol. 132, Apr. 10, 1936, pages 671-672; Apr. 24, 1936, page 754; *Engineering,* Vol. 146, Apr. 17, 1936, pages 439-440. The work done and results and conclusions reached since 1922 are reviewed. The utility of testing by simulating practical conditions is discussed. Electrolytic action depends on metallic factors and environmental factors, i.e. state of strain, crystal structure, hydrogen over-potential, chemical reactivity and temperature, supply of O, concentration of H, and electrical conductivity of the solution. The stages of corrosion and formation of protective oxide films depending on these factors are discussed individually. Ha + VSP (13)

Photo-electric Activity of Iron and Its Oxides. James S. Hunter. *Nature,* Vol. 137, Mar. 14, 1936, page 460. Measurements of the photo-electric sensitivity, in light of different wave lengths, of surfaces of Fe, Fe_2O_3, and FeO, support theory of gas adsorption rather than instantaneous oxidation as being the initial change undergone by a clean metal surface exposed to the air. CSB (13)

Metals and Alloys in Acid Mine Water. *Mining Congress Journal,* Vol. 22, May 1936, page 92. First use of high Cr-Fe alloys in the coal mining fields was in 1922. Alloys with up to 30% Cr were used. The first difficulties encountered were eliminated as proper casting technique was developed. Now many successful installations of these alloys are found in both the anthracite and the bituminous fields. Many mines report Cr-Fe castings which show no appreciable evidence of corrosion after 7-10 years of service. Alloys with 27-30% Cr have been found satisfactory, while 12-14% Cr and 16-18% Cr do not stand up. Lately Ni has been added, and this has eliminated many foundry difficulties. Recently it has been found that small additions of N greatly increase the strength of Cr castings and refine their grain, but no definite data have yet been obtained in regard to the effect of this element on the corrosion resistance. BHS (13)

Chemical Behavior of Bearing White Metals (Beitrag zur Frage des chemischen Verhaltens der Lager-Weissmetalle) Report of Committee for Non-ferrous Metals. *Korrosion & Metallschutz,* Vol. 12, Mar. 1936, pages 50-52. Investigations had object of determining the catalytic effect of different metals on transformer oil heated in the absence of air. It was found that a 70 hr. heating to 120° C. in presence of Pb, Zn and Sn does not change the oil. The dissolving power of oils for bearing metals was further investigated; the results are shown in curves, pure Pb showing the least loss of weight. Atmospheric influences are very strong, some bearings being entirely destroyed after 2 years storage. 8 references. Ha (13)

Deterioration of Structures in Sea Water. *Engineer,* Vol. 161, Apr. 10, 1936, pages 394-395. Abstract of the 15th report of the Committee of the Institution of Civil Engineers, known as Sea action committee. Parts 2 and 3 are concerned with the corrosion and protection of Fe and steel. VSP (13)

Standardization in the Realm of Corrosion (Normungsarbeiten auf dem Gebiete der korrosion) *Chemische Fabrik,* Vol. 9, Apr. 17, 1936, pages 178-181. Detailed reports containing "tentative specifications" of units of measure, and methods and equipment to be used in corrosion research are submitted by committees of the Deutsche Gesellschaft für chemisches Apparatewesen. FPP (13)

Condenser Performance. V. Walker. *Electrical Review,* Vol. 118, May 15, 1936, page 710. To inhibit fouling of tubes where slime and algae are encountered, circulating H_2O is chlorinated. Tests carried out on Admiralty brass tubes with chlorinated and unchlorinated sea-H_2O indicated that chlorination caused twice as much loss of weight of tube material. Rate of loss due to chlorination decreased continuously. Local dezincification is not as harmful as general dezincification. When upper row of tubes are frequently empty, the resulting high temperatures aggravate tendency towards dezincification. Circulating H_2O containing H_2S is particularly bad for Cu or brass condensers. In some cases inlet ends of tubes are coated with cement paint or "bitumastic" solution to prevent corrosion. Many alloys, such as Cu-Ni, are superior to Admiralty and brass alloys for condenser tubes. Al brass withstands impingement attacks. MS (13)

Deterioration of Structures in Sea Water. 15th Report of the Committee of the Institution of Civil Engineers. Edited by S. M. Dixon & H. J. Grose. His Majesty's Stationery Office, London, 1935. Cloth, 6 x 9¼ inches, 137 pages. Price 12s. 6d.

Connected account written by J. N. Friend of experiments continued for 10 to 15 years on atmospheric and sea water (complete immersion and half-tide) at Aukland, N.Z., Colombo, Halifax, N.S. and Plymouth, together with fresh water immersion at Plymouth on wrought and ingot irons, low, medium and 0.40% C steels, mild steel with 0.6 and 2.2% Cu, 13½% Cr steel, 3-¾% Ni and 36% Ni steel, and hot blast and cold blast cast iron. The 36% Ni steel was superior under all conditions, behavior of the others varied with conditions. Wrought Fe was better than steel in sea water, equal in fresh, inferior in the air. Cast Fe was very good in air. C content did not greatly affect the performance of the steels. The Cu steels showed benefit from Cu in air and fresh water. The Cr steel was good in air and fresh water but pitted badly in sea water. 3-¾% Ni in a .31% C steel helped in air and fresh water, not in sea water. Mill scale was always bad. Full tables and many photos are given. Mild steel painted plates, were exposed at Southampton and Weston-super-Mare for shorter periods. Fe oxide, red and white Pb paints and some of these with a Pb chromate primer, tar and galvanized coatings were used. Mill scale was bad. The Pb chromate primer helped, but tar behaved better than paint. Tar, followed by shellac, followed by paint, was very successful. Full tables are given. Something over half the book is devoted to bare or painted Fe and steel. Other chapters deal with similar tests on timber and concrete. H. W. Gillett (13)—B—

The Corrosion of Metals—I. Mechanism of Corrosion Processes. R. M. Burns. *Bell System Technical Journal,* Vol. 15, Jan. 1936, pages 20-38. Metallic corrosion consists either of a direct combination of the metal with a non-metal in its environment or a combination in which H is displaced from the medium at the surface. This latter or displacement type is involved in the corrosion of metals in moist air, soil, and water, and is electrolytic in nature since it depends on the operation of small surface galvanic elements. The amount of corrosion will depend on the flow of current between these anodic and cathodic areas. The purpose of this paper is to present a generalized electrochemical theory of corrosion of the displacement type. From this it is evident that a knowledge of the anodic and cathodic current density and potential relationships existing on the surface of a metal in a given environment would lead to an understanding of the corrosion process and to predictability of corrosion behavior. While it is not possible to measure these quantities directly because the sizes of these areas are unknown, the potential-time curve is a composite of the resultant potentials and their change with time. It will indicate if the process is anodically or cathodically controlled and in some cases even determine the rate. Furthermore it is possible to determine a measure of the stability of the protective film in terms of the leakage current which may be passed through the film, or in terms of the amount of film-forming material required to produce passivity or in terms of the amount of film destroying material required to render the metal active. The rate at which a film forms on a metal also gives information on the relative surface reactivity of the metal. With the aid of such measurements and an exact knowledge of the metal and its environmental conditions it is possible to predict corrosion behavior and gain an understanding of such processes not given by the usual empirical tests. HFK (13)

Effect of Impurities on Corrosion Resistance of Solder. Clifford L. Barber. *Industrial & Engineering Chemistry,* Vol. 28, May 1936, pages 530-533. Tests indicate that Sb, Cu, and Zn should be excluded from Sn alloys from the corrosion-resistance standpoint, because they decrease corrosion resistance. MEH (13)

The Influence of Light on Electrode Potential and Corrosion Phenomena of Certain Non-ferrous Metals. C. O. Bannister & R. Rigby. *Engineering,* Vol. 141, Mar. 20, 1936, page 321. See *Metals & Alloys,* Vol. 7, June 1936, page MA 316R/6. VSP (13)

The Abrasion of Chain Wheels. C. C. Downie. *Crushing, Grinding, Mining & Quarrying Journal,* Vol. 3, Jan.-Feb. 1936, pages 196, 198. Heat-treated C steel, Ni-, Ni-Cr-, and Mn-steels and Ni- and Cr-cast Fe are used to resist abrasion. AHE (13)

Corrosion of Copper—Controlling Factors in Unaërated Solutions of Sulfuric Acid. Glenn H. Damon & Ray C. Cross. *Industrial & Engineering Chemistry,* Vol. 28, Feb. 1936, pages 231-233. Experiments show that the corrosion rate of Cu in H_2SO_4 is directly proportional to O solubility in the acid up to about 25 normal acid; above this concentration the oxidizing character of H_2SO_4 affects the corrosion rate. The maximum corrosion rate for Cu in unaërated 0.2 normal acid is about 40 mg./dm.^{2}/24 hrs. It is suggested that standard corrosion test methods should specify the solution surface area if reproducible results are to be obtained, and that the same factors should control the corrosion rate for all metals which depend upon O depolarization. A subsequent paper will report on some of the more active metals. MEH (13)

Drop Test (L'essai par les gouttes) U. R. Evans. *Revue de Métallurgie,* Vol. 33, Apr. 1936, pages 217-220. Brief summation of the results previously published. JDG (13)

Microchemical Analytical Methods Applied to Corrosion of Light Al Alloys (Sur l'Application des Méthodes d'Analyses Microchimiques à l'Étude de la Corrosion des Alliages Légers d'Aluminium) Henri Fournier. *Comptes Rendus,* Vol. 202, May 25, 1936, pages 1792-1794. Alloys used were (1) duralumin type containing 3.8% Cu, 0.41% Fe, 0.35% Si, 0.46% Mn and 0.91% Mg and (2) Al-Mg alloy containing 0.32% Si, 0.54% Mn and 8.65% Mg. Samples were immersed in a 10% NaCl solution so that the quantity of liquid is small compared to the surface of the sample exposed to the corroding medium. The dissolved products are analyzed by microchemical methods and curves are drawn to show the variation in concentration of the solution as a function of the time. FHC (13)

Oxide Films of Some Alloys. Ichirô Iitaka & Shizuo Miyake. *Nature,* Vol. 137, Mar. 14, 1936, page 457. Electron diffraction patterns indicate that the resistance to high temperature oxidation is due in Cu-Be alloys to a surface film of BeO (hexagonal, $a_o = 2.70$ A.U., $C_o = 4.39$ A.U.) which appears in alloys containing over 1% Be, and in Nichrome to a surface film of $NiCr_2O_4$ or $NiO.Cr_2O_3$ (cubic, $a_o = 8.30$ A.U.). CSB (13)

14. APPLICATION OF METALS AND ALLOYS

Internal Combustion Engine Governors of Stainless Steel and Aluminum. *Steel,* Vol. 98, Mar. 30, 1936, pages 47-48. Hoof Products Co., Chicago, builds all important units of its governors of stainless steel, while body, cover, and housing are Al die castings. Cantilever spring is used in place of light coil springs commonly employed. MS (14)

American Standard Socket Set Screws and Socket Head Cap Screws. *American Standards Association,* A. S. A. No. B 18.3-1936, 11 pages. AHE (14)

Powder Metallurgy, A Warning, A Promise. Gregory J. Comstock. *Metal Progress,* Vol. 30, July 1936, pages 49-50. Use of metal powders to produce articles of pure metals and common alloys offers promise of great possibilities. Time and additional extensive research are required for their achievement. WLC (14)

Bicycle Manufacture Involves Many Manual Operations. Fred B. Jacobs. *Iron Age,* Vol. 137, Mar. 26, 1936, pages 43-47. Outlines several of the major manufacturing and assembling practices at the plant of the Shelby Cycle Co. Frames and handle bars are made of high grade seamless tubing and frame connections are steel stampings. Connections are blanked and drawn under special dies. Pedals, rims, tires, spokes, hubs, etc., are purchased ready made. VSP (14)

14a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

Metal Sprayed on Wood. *Engineering,* Vol. 141, Apr. 3, 1936, page 381. Discusses the process of metal spraying, using wire melted by blow-pipe and deposited on wood. Results showed that metals of low melting point, such as Sn, Pb and Zn sprayed on wood, reduced its susceptibility to changes in moisture content and dimensions due to variations in humidity of atmosphere by from 1/4 to 1/3. Metals melting at high temperatures, like bronze, brass, Cu and Al, do not protect wood. Sprayed metal does not protect wood against absorption of H_2O during soaking. VSP (14a)

Tungsten Alloys and Compounds. *Chemical Trade Journal & Chemical Engineer,* Vol. 98, Feb. 21, 1936, page 148. See "The Commercial Development of Tungsten," *Metals & Alloys,* Vol. 7, June 1936, page MA 319L/8. MS (14a)

American Standard Brass Fittings for Flared Copper Tubes for Maximum Cold Water Service Pressure of 175 Lb. per Sq. In. (Gage). *American Standards Association,* A. S. A. No.: A 40.2-1936, 5 pages. AHE (14a)

Copper Alloys to Meet Severe Requirements. D. K. Crampton. *Metal Progress,* Vol. 29, May 1936, pages 39-43, 100. Trend toward use of thinner stock and more complicated designs in deep drawn articles of brass are discussed. Problems of finish, more severe drawing and less frequent annealing are discussed. Pb and Fe must be held below 0.05% for good deep drawing quality though where machining after drawing is to be employed more Pb may be tolerated. Where no final annealing operation is applied and season cracking may be a hazard, alloys containing over 80% Cu should be used. 85-95% Cu alloys are more workable than lower Cu compositions. Where brazing is to be employed at least 72-75% Cu must be used to give sufficiently high m.p. Si bronze for evaporator unit has good workability and weldability with smooth surface and high strength. WLC (14a)

14b. Ferrous

M. GENSAMER, SECTION EDITOR

Stainless Steel Proving Serviceable in Variety of Dairy Equipment. *Steel,* Vol. 98, Jan. 13, 1936, pages 34-35. Stainless steel is finding increased use in dairy equipment, as it is able to overcome objections to certain other metals. Describes its use for lining pasteurizers and storage and truck tanks. MS (14b)

New Applications of Nickel Steels and Alloys. *Machinery,* N. Y., Vol. 42, Jan. 1936, pages 318-320. Recent progress in the uses of Ni steels and alloys in the mechanical industries is reviewed and examples are described. Ha (14b)

The Motohome—a Prefabricated Steel-Frame House. *Iron Age,* Vol. 136, Nov. 7, 1935, pages 35-37, 100. Describes a prefabricated steel frame house developed by American Houses, Inc., New York. Amount of steel used in construction of "Motohome" ranges from 1 1/2 tons for smallest model, with 4 rooms and bath, to 2 1/4 tons for a 7 room house. VSP (14b)

Aluminum's Future. W. S. McArdle. *Scientific American,* Vol. 154, Feb. 1936, pages 65-67. Applications and development of Al alloys are traced. CBJ (14b)

Nitralloy Cylinder Barrels for Airplane Engines. Edwin F. Cone. *Metals & Alloys,* Vol. 7, May 1936, pages 119-121. Describes forging and heat treatment of airplane cylinder barrels made of nitralloy from hot rolled bar stock to assembly in engines. WLC (14b)

Sheet Metal Base for Bath Tubs Competes with Cast Iron. Bennett Chapple. *Metal Progress,* Vol. 29, Feb. 1936, pages 47-48. Describes process of production and characteristics of enameled sanitary ware with a 14 gage sheet base. 1/3 less weight results in lower shipping costs and fewer men for installation. WLC (14b)

Steel Rolling Shutters. Ben Frisby. *Power & Works Engineer,* Vol. 31, Jan. 1936, pages 19-21. Various types of steel rolling shutters available are described and illustrated. Their development has afforded savings in floor space, reduction of fire risk and protection against weather, theft, etc. FPP (14b)

Notes on Trends in Nitriding of Steel. Federico Giolitti. *Metal Progress,* Vol. 29, Mar. 1936, pages 68-69. Discusses grades of nitriding steel used in Europe. Application of nitrided steel to regulating needles of hydraulic turbines shows nitrided steel to be twice as good as nearest competitor and 8 1/2 times as good as material costing 1/2 as much. WLC (14b)

What Steel Is Best for This or That Part? William H. Graves. *Metal Progress,* Vol. 29, Apr. 1936, pages 36-42. Gives data on steels used in 6 different automobiles for various parts. Different producers show considerable variation in materials used for same parts. The data indicate that high alloy steels are not commonly in use and that the trend is toward lower alloy content or plain C steels. WLC (14b)

The Dies Used in Brass Die-Casting. Chas. O. Herb. *Machinery,* N. Y., Vol. 42, June 1936, pages 638-640. One of the most satisfactory steels for die-casting dies is composed of W 10-12%, C 0.30-0.40%, Cr 1.75%, V 0.5%. Proper heat treatment, heating to 300°-400° F. before using, preventing the die from becoming hotter than 600° F. in operation, cooling with running water, and daily polishing assure long life. Ha (14b)

Nickel Steels in Railway Engineering. L. W. Johnson. *Railway Gazette,* Vol. 64, Apr. 10, 1936, pages 700-702. Recent intense competition in railroad industry has forced important replacements of wrought Fe and C steel by higher tensile strength alloy steels. Discusses generally beneficial effect of Ni in steel. Composition and physical properties of .20-.25 C steel containing 1.75 to 2.0% Ni for boiler plates and firebox plates are given, and the effect of "aging" on the impact values of various steels with and without Ni is illustrated. Increase in Ni content of low C steels reduces "aging" embrittlement. FPP (14b)

Fundamentals of Light Construction. Part I. (Grundlagen des Leichtbaues. (I Teil)) E. Kreissig. *Stahl und Eisen,* Vol. 56, Jan. 9, 1936, pages 33-39. Safety in thin sections is secured by means of strong, ductile, and corrosion resisting steels. The importance of compressive as well as tensile stresses is emphasized. The influence of welding on the development of light construction is brought out. Various types of hollow beam construction are illustrated. SE (14b)

Fundamentals of Light Construction. Part II. (Grundlagen des Leichtbaues. (II Teil) O. Paulssen. *Stahl und Eisen.* Vol. 56, Jan. 23, 1936, pages 81-86. Light construction in railroads, ships, and airships is discussed. SE (14b)

Principles of Pressure Die Design—Technique for Various Die-Casting Alloys. E. Stevan. *Metal Industry,* London, Vol. 47, Dec. 13, 1935, pages 579-582. As most of the commercial die-casting today is of alloys of Zn, Al, or Cu, die design is determined by the melting point of the alloy to be employed, by contraction factors, by methods of casting and type of machine to be used. The technique of die design must be comprehensive, elastic and is frequently unorthodox since practically each new piece undertaken has its individual problem. Factors to be considered for a new piece, after determining its function and the material from which it is to be made, are methods of production, permissible cost, type of machine most suitable, methods of parting mold, type of core, gating, etc. Tool room equipment should also be taken into consideration. Several types of dies are described. Materials for die construction are dependent upon the quantity required, as cost is a major item. A method that may be used where extreme accuracy is not required is suggested. Methods of parting molds are considered for upon this may depend production that is economical and free from trouble. Some examples are discussed. Different methods are suggested for the removal of cores. HBG (14b)

Metal in Functional Architecture—Its Proponents' Views. F. Charles Thum. *Metal Progress,* Vol. 29, Feb. 1936, pages 43-46. Discoloration of exterior trim near the street level in congested city atmosphere produces results unsatisfactory to builder and owner. Absence of thoroughly adaptable small unit section acts against increased use of metal. WLC (14b)

Armour Plate and Ordinance. *Times* [*London*] *Trade & Engineering,* Vol. 38, Apr. 1936, page XV. Outlines developments in manufacture of armor-plate and ordnance and steels therefor. MS (14b)

Steel Containers for Beverages (Stahlbehälter für Getränke) *Montanistische Rundschau,* Vol. 28, June 16, 1936, (Section *Stahlbau-Technik*) pages 7-8. Hofius, Duisburg, Germany, has developed a process for storing milk in containers of stainless steel. By keeping the milk between definite temperature ranges and under a certain oxygen pressure it has been found possible to keep it fresh for about 2 months, with no change in chemical or bacteriological properties, and with no taste of the steel. Also discusses the use of steel containers for storing and shipping beer, which permit a saving of 40% in weight of packing and 60% in space. BHS (14b)

Heat Resistant Steel for Aeronautic Motors (Eine hitzebeständige Stahlsorte für Flugmotoren) *Montanistische Rundschau,* Vol. 28, June 16, 1936, (Section *Stahlbau-Technik*) page 7. Tests at the Moscow Institute for Aeronautic Materials have shown that an 18:8 steel containing Ti and a high percentage of Si gives very good service in the exhaust system of aeronautic motors. It has heat resistance, strength and elasticity at elevated temperatures, and is easily welded. Yield point 25-30 kg./mm.^{2}; elongation 45-55%; hardness 165-180 Brinell. BHS (14b)

Properties of Principal Cr-Fe and Cr-Ni-Fe Alloys. *Metal Progress,* Vol. 29, June 1936, pages 56-57. Tables showing properties of these alloys. WLC (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Report for the Year 1935. National Physical Laboratory. His Majesty's Stationery Office, London, 1936. Paper, 8 x 10¾ inches, 249 pages. Price 12s.

Among metallurgical problems under investigation in 1935 were X-ray study of cold worked metals of electrodeposited coatings of transformer steels and of metal undergoing fatigue. In the last, fragmentation was noted at stresses that would ultimately cause failure. CuCr alloys for resistance standards are being tried. Wear of metals, ductility testing of thin sheet, Al under alternating torsion, fatigue under combined stresses, with different surface conditions, and in different atmospheres and corrosive media, creep and stability of C and CMo steels, high temperature properties of gaskets and bolting materials, cracking of boiler plate, journal friction, strength of welds, Ti and Al alloys, contact corrosion under pressure, seizing of bearings, tests of cast crankshaft materials, pure Fe and pure Fe-C alloys, oxidation of metals, analytical methods, AlCuSi alloys, solubility of H_2 in Al, MgCdAlAg, grain size and "heredity" in Al alloys, growth of cast iron, gases and oxides in steel and dental alloys were all given attention. The work is carried on in the departments of metallurgy, engineering and physics.
H. W. Gillett (15) -B-

Technical Teaching in Theory and Practice. C. H. Creasey. George Routledge & Sons, Ltd., London, 1935. Cloth, 5 x 7½ inches, 151 pages. Price 3s. 6d.

The author has spent 39 years in the British Colleges and technical schools, "during which time he has had unusual opportunities of observing the discouragement and economic loss which results from each generation of teachers having to carry on their work without special training or the benefit of transmitted experience . . . The book is the result not merely of observation and teaching experience, but of hundreds of lectures, formal and informal discussions, and talks to many types of teachers, in a wide variety of subjects, over a long period of time."

The book contains the following chapters: How the Mind Works; The Devices of Teaching; General and Special Methods; and Personal Relations. This information will not only be of value to educator but also to the operating executive, who must also convey information but often under extremely unfavorable circumstances.
Richard Rimbach (15) -B-

Fire Risks on Magnesium Alloys. *Aluminium & Non-Ferrous Review,* Vol. 1, May 1936, pages 373-375. Reports by Fire Brigade officers on the ignition of Elektron swarf are reproduced and criticized. Liquid extinguishers should not be used, but the fire smothered with asbestos cloths or sand. JCC (15)

Investigation of Accidents on Niter Baths (Untersuchung von Unfallereignissen an Salpeterbädern) Haid & Frenzel. *Oberflächentechnik,* Vol. 13, May 5, 1936, pages 102-103. A number of cases are described where serious explosions occurred when pieces of light metal were treated in a melt of K-Na nitrate at 500° C. The reason is usually a very strong reaction between the Fe container and the melt due to a thermite-like mixture of Fe oxide and pieces of Al which ignite and melt the container so that the molten mass runs out. The reaction is started by local overheating of the container. At ordinary temperatures of the baths, Al is quite inert against the molten niter and cannot be ignited even by burning material dipped into the bath. If the temperature is, however, sufficiently high a strong reaction of the melt with even solid Al takes place which is still more favored by the fact that Al above its melting point (657° C.) absorbs liquid niter like a sponge. It is recommended always to supervise the bath and to prevent the temperature from rising above 600° C. Al collecting in the bath should be regularly removed. Ha (15)

15a. Economic

Development Movement in Non-ferrous Metallurgical Industry. W. R. Barclay. *Engineering,* Vol. 141, Mar. 13, 1936, pages 292-293. See "Presidential Address," *Metals & Alloys,* Vol. 7, June 1936, page MA 321L/5. VSP (15a)

Variation in the Price of Base Metals. Robert Annan. *Bulletin Institution Mining & Metallurgy* No. 381, June 1936, pages 17-28. The problem of estimating future base metal prices is discussed. AHE (15a)

Manganese Ore Industry in 1935—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 471, July 2, 1936, 4 pages. Statistical. AHE (15a)

Molybdenum Industry in 1935—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 462, June 11, 1936, 2 pages. Statistical. AHE (15a)

Platinum and Allied Metals in 1935—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 469, June 25, 1936, 5 pages. Statistical. AHE (15a)

Tungsten Industry in 1935—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 463, June 11, 1936, 1 page. Statistical. AHE (15a)

Economics of the Aluminum Industry. Francis C. Frary. *Industrial & Engineering Chemistry,* Vol. 28, Feb. 1936, pages 146-152. A brief review of the discovery by Hall of the electrolytic process for Al manufacture, and an analysis of the main factors involved in the production of the pig metal at the reduction plant: cost of materials consumed, cost of power, repairs and maintenance, labor, and overhead. Competition with other metals, and the future of the Al industry are also briefly discussed. MEH (15a)

International Annual of Minerals and Metals (Annuaire International des Minerais et Métaux) Société des Publications Mineres et Métallurgiques, Paris 1936. Fabrikoid, 6¼ x 10 inches, 439 pages. Price 55 Fr. Directory of producers in France, French colonies, Luxembourg, Belgium and Belgian Congo. Foreign companies exporting to France are included. R. Rimbach (15a) -B-

Secondary Copper. Its Production, Consumption, and Market Effect. Percy E. Barbour. Mining & Metallurgical Society of America, New York, 1936. Paper, 6 x 9 inches, 85 pages. Price $1.50.

This study, according to the preface, is presented as a report from the Committee on Foreign and Domestic Mining Policy of the Society, but it should be pointed out that the opinions expressed are those of an individual and should therefore be taken as such. This in no way reflects upon Mr. Barbour's ability to treat a most difficult subject as we know of no individual better qualified to pass judgment on secondary Cu than the author.

The report deals fundamentally with the statistical and economic position of secondary Cu as it affects the market for the primary metal. It is therefore a treatise in which the average metallurgical engineer will find little of interest unless he is one of the school that appreciates that in this day and age the purely technical and economic aspects of any problem must be considered jointly.

Following a brief discussion of plants, classification and sources of secondary materials, the author launches into a presentation of statistical data on scrap and secondary Cu in their relation to primary, or virgin, metal. Although ample data are presented, one who is just being introduced to the subject will find it difficult to understanad and appraise the numerous factors which play important roles in affecting markets for both secondary and primary. We become imbued with the idea that secondary Cu is really only a small part of the industry and statistically this may be true, but it has a much more important effect on markets than would be inferred from Mr. Barbour's discussion. We must also assume from the phraseology employed that under normal conditions the price of refinery Cu has no material effect on secondary production or on the market price of Cu. These statements may be acceptable within certain limits but there are so many different conditions to analyze that it is not within the scope of this review to consider them.

We must not lose sight of the fact that all Cu rich scrap is Cu, when appraised from the secondary angle. Materials falling into this category are always a threat to the stability of the primary market as they directly and indirectly affect the price structure.

This work will serve as an excellent introduction to a phase of the industry which is becoming increasingly important. Although we cannot whole-heartedly agree with certain conclusions drawn by the author, we highly recommend the report as the most complete treatise yet published on the fascinating and complex subject of secondary Cu. G. L. Craig (15a) -B-

British Iron and Steel Industry. William J. Larke. *Times [London] Trade & Engineering,* Vol. 38, Jan. 1936, page XXI. Discusses reorganization of the industry which occurred in 1935, recovery made in production and employment, increase in export trade, and outlook. MS (15a)

Cadmium Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 453, May 15, 1936, 1 page. Statistical. AHE (15a)

Copper Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 454, May 20, 1936, 6 pages. Statistical. AHE (15a)

Lead Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 455, May 19, 1936, 3 pages. Statistical. AHE (15a)

Mercury Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 467, June 24, 1936, 2 pages. Statistical. AHE (15a)

Iron and Steel Industry. *Times [London] Trade & Engineering,* Vol. 38, Feb. 1936, page XI. Discusses recent important developments in the East Midlands district of England. It is the most important Fe-ore producing region in the United Kingdom and the most important pig-Fe producing district in the country. Production of steel is increasing. MS (15a)

15b. Historical

Iron and Steel. *Times [London] Trade & Engineering,* Vol. 38, Dec. 1935, page XI. History and recent tendencies of the Fe and steel industry in the West Midlands district of England. At present it is producing more than 10% of the total output of steel ingots and castings in the United Kingdom. MS (15b)

Brass and Copper. *Times [London] Trade & Engineering,* Vol. 38, Dec. 1935, page XVI. Outlines progress of the brass and Cu industries of Birmingham, England, during the past 2 centuries. Includes technical developments. MS (15b)

Copper Working in France in the Middle Ages (Le Travail du Cuivre autrefois la Dinanderie francaise au Moyen Age) A. Chaplet. *Cuivre et Laiton,* Vol. 9, Apr. 30, 1936, pages 183-185. Historical sketch on the artistic and decorative uses of cast Cu, etching and working of Cu with illustrations. Ha (15b)

Institutes for Research in Ferrous and Non-Ferrous Metals. Hans Diergarten. *Metal Progress,* Vol. 29, May 1936, pages 70-71. Describes new research organizations of Germany. WLC (15b)

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Rise of Industrial Sheffield. Samuel Roberts. *Times [London] Trade & Engineering*, Vol. 38, Apr. 1936, page IV. History of the steel, cutlery, and silverware trades. MS (15b)

Sheffield Steel. Riverdale. *Times [London] Trade & Engineering*, Vol. 38, Apr. 1936, page III. Discusses changes which have taken place in the steel trade during the past 50 years. MS (15b)

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The Dillinger Steel Works (Die Dillinger Hüttenwerke) H. van Ham. *Stahl und Eisen*, Vol. 55, Dec. 19, 1935, pages 1536-1541. The plant, established 250 years ago is described, also its development and modernization. See also *Metals & Alloys*, Vol. 7, June 1936, page MA 322L/10. SE (15b)

FREE SERVICE DEPARTMENT

Wanted:—By a well-known manufacturer of Heat and Acid Resisting Castings Sales Representatives who are acquainted with buyers and operating heads in the Steel, Automobile, Chemical and Oil Industries in the following territories: New York, Boston, Philadelphia, Chicago, Cincinnati, Houston and Birmingham. No objection to one or two more lines. Reply giving references and full information as to qualifications. Address Box MA-2, Care of Metals & Alloys, 330 W. 42nd St., New York, N. Y.

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Junior Executive Available—M. I. T. Graduate. General engineering experience, Chase Brass and Copper Company. Purchasing chemicals and equipment, R. H. Macy and Company. Single, Christian, references. Box No. MA-4, METALS & ALLOYS, 330 West 42nd Street, New York, N. Y.

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WELDING ENGINEER, metallurgical experience with sales background. Experience in design, estimating and research, sheet metal and heavy structures. Not actively employed at present. Permanent connection desired. Box MA-14, care of METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

CURRENT NEWS ITEMS

Harry E. Sheldon Honored

An inter-community holiday and celebration, sponsored by a committee of the Upper Allegheny Valley Citizenry, was held in Brackenridge, Pa., Sept. 17, in recognition of the civic benefactions of Harry E. Sheldon, 75 year old founder-president of the Allegheny Steel Co. The communities of Tarentum, Natrona Heights, Harrison Township and Brackenridge, Pa., in which the principal plants of the company are situated and in which most of the employees live, organized the celebration but delegations from most of the communities within a five mile radius participated.

More than 10,000 children, volunteer firemen, American Legionnaires, steel mill workers, member of civic organizations and plain citizens took part in a parade which required more than 2 hours to pass the reviewing stand. Included were 84 employees, still active in the company, who started with Mr. Sheldon when it was organized 35 years ago.

Mr. Sheldon was referred to as the founder of stainless steel in America, and the creator of an enterprise bringing work and homes to thousands. He was presented with a stainless steel plaque by S. M. Hazlett, chairman of the Citizens Committee as a testimonial of the associated communities, who pointed out that Mr. Sheldon's enterprises has brought over $120,000,000 in wages to the communities in 35 years and has furnished with but one or two brief interruptions continuous employment for thousands of men during that time.

International Acetylene Association to Meet in St. Louis

The International Acetylene Association will hold its thirty-seventh annual convention in St. Louis at the Jefferson Hotel, Nov. 18, 19 and 20. This will be the first time that the convention has been held in St. Louis.

Technical sessions will be held each afternoon and on two evenings. The oxy-acetylene process for welding and cutting metals will be featured at these sessions. As the result of a year of unusual developments, a series of vitally interesting subjects will be discussed by speakers who are key men in their fields. Wednesday evening, Nov. 18, is to be devoted to a forum on welding and cutting. The evening session, Thursday, Nov. 19, is intended to comprise a series of popular round-table discussions on oxy-acetylene welding and cutting practices.

Dr. Warner to Teach Metallurgy at Carnegie

Dr. J. C. Warner, associate profesor of theoretical chemistry and for the past ten years a member of the faculty of the chemistry department at the Carnegie Institute of Technology, has been appointed associate professor of metallurgy at Tech, effective at the beginning of the fall term.

An authority on physical chemistry, Dr. Warner will develop a teaching and research program in this field as it applies to the melting and refining of metals. Having already organized an extensive program of research in metals, Tech now plans to develop an experimental laboratory for undergraduates in process metallurgy. The melting and refining of metals offers a particularly appropriate field for Carnegie to emphasize, located as it is in the center of the iron and steel industry.

J. Fletcher Harper has resigned as research engineer with the Allis-Chalmers Mfg. Co., Wilwaukee, to become associated with the **Globe-Union Mfg. Co.** of the same city, makers of storage batteries, radio parts, steel roller skates and so on. Mr. Harper was graduated from the college of engineering of the University of Wisconsin and is widely known in metallurgical circles. He is a past president of the American Society for Metals. Harold Stein has been appointed to succeed Mr. Harper. He is a graduate of Tri-State College and has been with the Allis-Chalmers company since 1916.

Symposium on Corrosion Resistant Metals for Machinery

A remarkable symposium on "Corrosion Resistant Metals in Design of Machinery and Equipment" will be held as part of the American Society of Mechanical Engineers' annual meeting in New York, Nov. 30 to Dec. 4. The information presented is to be in compact form, of a practical nature, free from lengthy theoretical discussions but still sufficiently complete that when the different papers are assembled they will form a handy reference for the engineer of the subject of corrosion resistant metals.

The need for such a symposium was expressed by designing and operating engineers of the country who are constantly confronted with many problems on corrosion. They are busy men and not many of them have been able to follow closely the rapid development of this type of information during the past few years. Several of the professional divisions of the society joined in developing the symposium making it a feature of the A.S.M.E. annual meeting where it has been allotted the whole day of Thursday, Dec. 3 with three sessions in the morning, afternoon and evening. T. H. Wickenden, past chairman of the Society's iron and steel division, was appointed chairman of the committee that is arranging the symposium.

Several methods of presentation had been considered to present the material but the most feasible appeared to be according to the different base metals. The papers to be presented are as follows:

"Introduction to Corrosion Resisting Metals" by Dr. F. N. Speller, National Tube Co., Pittsburgh.

"Alloys of Aluminum" by E. H. Dix, Jr., Aluminum Co. of America, New Kensington, Pa.

"Nickel and Nickel-Base Alloys" by F. L. LaQue, The International Nickel Co., Inc., New York.

"Zinc in the Chemical Industries" by E. A. Anderson, The New Jersey Zinc Co., Palmerton, Pa.

"Lead" by G. O. Hiers, National Lead Co., Brooklyn.

"Cast Iron in Chemical Equipment" by Dr. H. L. Maxwell, E. I. du Pont de Nemours Co., Inc., Wilmington, Del.

"Copper and Copper-Base Alloys" by R. A. Wilkins, Revere Copper & Brass, Inc., Rome, N. Y.

"Corrosion Resistant Steel (Stainless Type)" by J. H. Critchett, Union Carbide & Carbon Research Laboratories, Inc., New York.

Notre Dame Adds to Its Metallurgical Staff

Continued growth of interest in the field of metallurgy and the notable increase in enrollment in metallurgical courses at the University of Notre Dame have this year made necessary an addition to the teaching staff of the department of metallurgy. Dr. Carl F. Floe comes to the department from Washington State College, where he has been teaching metallurgy for several years. He takes the position of assistant professor of metallurgy, in charge of non-ferrous work. Dr. Floe is a graduate of Massachusetts Institute of Technology, where he received the doctorate in 1935.

A new firm, **Patton & Bruce,** has been formed in St. Louis to represent the boiler water conditioning and combustion control interests of the **Hagan Corp.,** of Pittsburgh, and its affiliates, Hall Laboratories, Inc., and The Buromin Co. Members of the firm are Russell Patton and Warren C. Bruce, located at 526 North Vandeventer Ave.

The New York office of **The Timken Steel & Tube Co., Arthur R. Adelberg,** district manager, is now located at 165 Broadway, Room 1000. Mr. Adelberg formerly had his office in The Timken Roller Bearing Co. offices at 16 W. 60th St.

An actual demonstration of how porcelain enamel is fused on metal will be presented by the Porcelain Enamel Institute during the American Gas Association Convention in Atlantic City, Oct. 25 to 30. This will be the same demonstration which the Institute's Educational Bureau has been conducting in department stores throughout the country during the last year. Porcelain enameled ash trays will be manufactured to show visitors at the convention how the porcelian enamel finish on their gas appliances is applied.

Contests in 1937 for Apprentices in Moulding and Pattern Making

The American Foundrymen's Association announces that the molding and pattern making contests, which met with such success at the May, 1936, convention, will again be held in 1937. The contests will be sponsored by the Association Committee on Foundry Apprentice Training, and competition will be held definitely in steel molding, iron molding and pattern making classes. If sufficient interest is evinced in the Non-Ferrous field, a competition will be authorized in that group also. First, second and third prizes of $40, $25 and $15 will be awarded in each class from entries sent to the 1937 Convention.

Regulations of the Committee provide that local contests may be held under the supervision of individual foundries or of foundry groups. Copies of the regulations may be secured by writing to the A. F. A. at 222 West Adams St., Chicago. The Apprentice Training Committee is composed of men who have had wide experience, and is representative of foundries of various types.

Foundry Conference at University of Iowa

The American Foundrymen's Association announces that an important two-day conference on foundry practice will be held at the University of Iowa, Iowa City, Iowa, Friday and Saturday, Oct. 30 and 31. The conference is being sponsored by the College of Engineering of the University, the A. F. A. through its Quad-City Chapter, and the Northern Iowa Foundrymen's Association.

The program will consist of sessions on melting practice, and control and other current foundry problems. Outstanding experts will give the talks and lead the discussions. The detailed program will be announced later.

This conference will be similar to the annual district conferences held at Michigan State College, East Lansing, Mich., last year, and is one of the several which the A. F. A. is assisting in developing for the purpose of bringing foundrymen together to discus their mutual problems.

"Carilloy" Alloy Steels

Announcement of the new trade name, "USS CARILLOY," to identify alloy steels produced by Carnegie-Illinois Steel Corp. has been made by this subsidiary of United States Steel Corp.

It is emphasized in the announcement that the new name "USS CARILLOY" does not signify a new product, nor does it apply to any single alloy steel. It is simply a new trade designation which will serve as a quality trademark for the entire group of well-known alloy steels previously marketed as "Carnegie-Illinois Alloy Steels."

Advertisements in current trade publications feature "USS CARILLOY" which is reproduced in a distinctive hand-lettered logotype that makes the new name a trademark as well as a product brand name.

The **Cooper Alloy Foundry Co.**, Elizabeth, N. J., announces a division through which is extended a new service. One of the original and largest producers of stainless steel castings since 1927, it has made special note of the shortcomings in alloy machining. In opening its new branch, it has incorporated principles that rectify former mistakes and remedy old deficiencies. The **Stainless Engineering & Machine Works** has been organized to supply a specialized machine work adapted to stainless and heat resisting metals. Informed by an able staff and equipped with adequate machinery, it is in a position to design and construct with any alloy, in particular stainless steel. The officials are Harry A. Cooper, president, and M. J. Roberts, vice-president and general manager.

The appointment of **Frank J. Laskey** as general purchasing agent for **Republic Steel Corp.**, Cleveland, has been announced by Carl A. Ilgenfritz, manager of purchases and raw materials. **Robert E. Sherratt** has been named assistant general purchasing agent.

Frederick S. Cook has been appointed Pacific Coast manager for **Robert W. Hunt Co.**, engineers, with headquarters at San Francisco.

Value of Census Figures to Industry

At a recent luncheon at the Metals and Minerals Exhibit, International Building, Rockefeller Center, New York, Dr. Vergil D. Reed, assistant director of the Bureau of Census, spoke on the vast value and importance of figures being constantly compiled by the Bureau.

The Bureau of Census, U. S. Department of Commerce, will have Mervyn V. Pallister in New York during the months of September and October, to acquaint business men in general with the vast amount of research material available through the Bureau of Census. This is the first time that the government has established this service anywhere outside of Washington. In a survey conducted on who uses the government Census figures, it was discovered that advertising agencies lead all others, manufacturers being second, and newspapers third. The data are very comprehensive, and of wide value to anyone interested in marketing, manufacturing, market analysis, plant or store location, sales territories, consumer analysis, industrial trends, etc. Mr. Pallister is making his headquarters at the Metal Products Exhibits, Inc., International Building, Rockefeller Center.

Lukenweld Elects New President

Everett Chapman, who has been vice president of Lukenweld, Inc., Coatesville, Pa., has been elected president of the company, according to an announcement by Robert W. Wolcott, president of Lukens Steel Company, of which the Lukenweld organization is a division. Mr. Chapman succeeds G. Donald Spackman, who was recently promoted to general superintendent of Lukens Steel Co.

Robert J. Whiting, who has been superintendent of Lukenweld, Inc., in charge of all manufacturing, has been elected vice president of Lukenweld, Inc.

Personals

M. H. Mawhinney has terminated his connection with the Salem Engineering Co., Salem, Ohio, and is now engaged in special consulting work.

E. J. Edwards, for many years engineer of tests for the American Locomotive Co., Schnectady, N. Y., has been promoted to chief metallurgical engineer. He is succeeded as engineer of tests by L. F. Mulholland.

H. Foster Bain is now with Samuel H. Dalbear and Lawrence B. Wright, mining engineers, New York.

T. L. Joseph has resigned from the Bureau of Mines to take a position as professor of metallurgy with the Minnesota School of Mines and Metallurgy. Mr. Joseph has conducted blast furnace investigations for the Bureau of Mines since 1919. For the past year he supervised a plant investigation conducted jointly by the Inland Steel Co., and the Bureau of Mines on the effect of oxides in pig iron on the oxides in basic open-hearth steel. F. W. Scott, who made the oxide determinations in this investigation, has resigned from the Inland Steel Co. and will be associated with Mr. Joseph in teaching and in conducting research.

Harry L. Campbell, for many years on the faculty of the University of Michigan has become associated with the American Hoist & Derrick Co., St. Paul, Minn., as metallurgical engineer.

Samuel Epstein, formerly associated with Battelle Memorial Institute, is now with the research and development department of the Bethlehem Steel Co., Bethlehem, Pa.

The Westinghouse Award, Order of Merit, has been conferred on **Norman L. Mochel**, metallurgical engineer, by the Westinghouse Electric & Mfg. Co., "for distinguished service to the industry in the field of metallurgy."

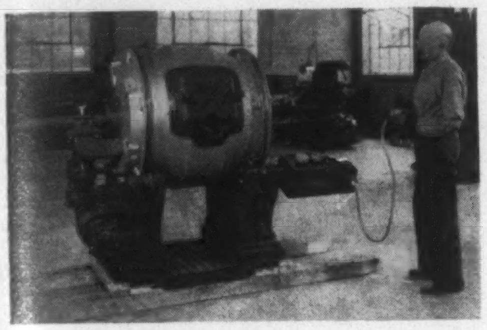
Further expanding its metallurgical service in the Detroit area, the **Union Drawn Steel Co.**, Massillon, Ohio, has announced the addition of **James R. Buchanan** to the field metallurgical staff of its Detroit district sales office.

NEW EQUIPMENT AND MATERIALS

New Detroit Rocking Furnace

A new 350-lb. furnace, "Type LFC," for high temperature melting, is announced by Detroit Electric Furnace Co., Detroit. It has been specially designed for melting copper, nickel, and alloy irons and steels.

A major change from the model LFA which it replaces is that the arc at the center of the furnace is farther away from the refractory than at the ends of the shell. The new shell is of larger diameter around the central portion than at the ends. A changed hearth design permits easier tapping and cleaning.



The new furnace is equipped with automatic rocking control, which is a recent development of the company, and likewise with a remote pouring switch which can be operated at some distance from the unit. A magnetic brake motor is included as standard equipment on the rocking mechanism.

It is believed that the improvements in the refractory and shell will result in longer refractory life, reduced power and electrode consumption, and a decrease in metal loss in the highly volatile alloys.

The shell and refractory design are such that the metal is constantly brought back to the hottest part of the furnace, being that part immediately adjacent to the arc, so that there is a constant action to provide a uniform temperature throughout the bath.

"Coppercote"—A Preservative Coating for Metals, etc.

Pure metallic copper of extreme fineness and of the irregular flaky structure known as "dendritic" can now be applied to iron, steel, wood, concrete, or other surfaces which require a protective coating of unusual effectiveness. This new coating is being produced under the name "Coppercote" and has been thoroughly tested, according to American Coppercote, Inc., New York.

Many corrosion problems were taken into account in the development of Coppercote which involved the production of a special vehicle in which the minute flakes of pure metallic copper remain in perfect suspension. While the coating is applied, a physico-chemical reaction occurs between the particles of copper and its vehicle. Since the copper is "dendritic" in structure rather than granular, a closely knit coating results which, when set, forms a tough hard metallic surface. When applied to a surface of ferrous metal it will positively prevent corrosion. When applied to a surface already rusted, it will arrest any further corrosive action. It will not crack, scale nor chip as a result of the extremes of temperature nor is it affected by the ultra violet rays of the sun. Coppercote has been demonstrated to be a non-conductor of electricity. Due to the insulative character of the coating, destructive electrolytic action is impossible.

Coppercote has been applied to steel columns under conditions of extreme dampness in the Eighth Ave. Subway, New York City. Perfect protection is still being given after a year of service.

Deeply corroded specimens of angle iron were treated with Coppercote and buried in coal cinders for one year. At the end of this period they were unearthed and found to be in perfect condition.

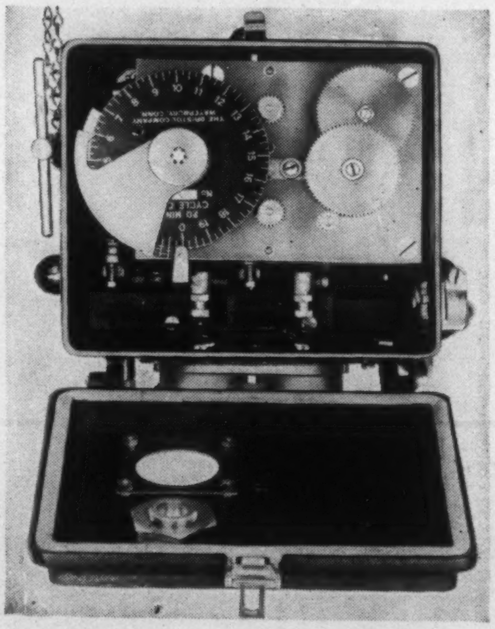
Steel specimens coated with Coppercote were buried in alkaline soil for two years. When dug up, they were found to be unaffected.

Coppercote coated steel panels were found to be unaffected by gasoline after immersion for extended periods of time.

It has been demonstrated that the application of Coppercote to wooden structures provides effective protection against the termite and also against marine borers including the teredo and limnoria. Coppercote is extremely fire resistant and its application to wooden structures will greatly reduce fire hazards.

New Process Cycle Controller

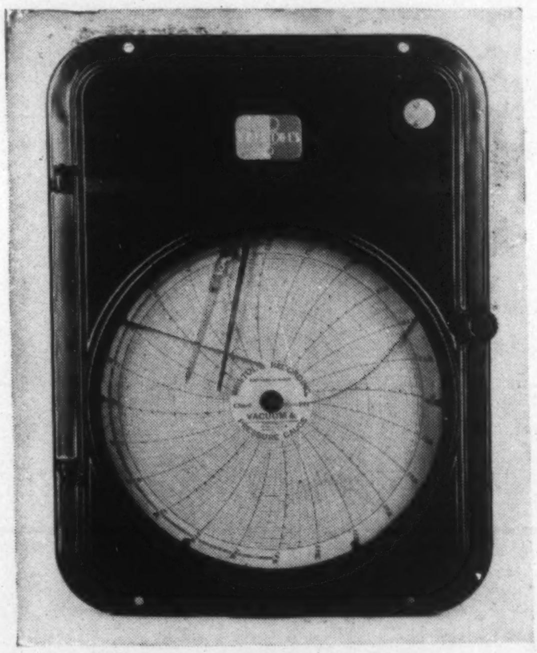
The Bristol Co., Waterbury, Conn., has developed a new process cycle controller, known as the "Model 6088V," to fulfill the many requirements, particularly in the rubber and molded plastics industries, where a variable speed controller is required. This instrument is suitable for automatically controlling any cycle operation which operates on a cycle that must be changed from time to time. It is equipped with one cam operating one or two patented, leakless, three-way pilot valves, as required by the process. The cam is readily adjustable to carry out any desired time cycle, regardless of duration, within the range of the controller cam.



A novel two-speed cam operating mechanism makes possible a multiplicity of speeds obtainable with but a single cam. The variable speed mechanism employed involves no gear shifts, governors, springs, or escapements. It is extremely simple in construction.

New Low-Range Pressure Recorders and Controllers

The Bristol Co., Waterbury, Conn., announces a new series of low-range recording gages and controllers, known as the Model D40M series. These instruments are equipped with enclosed bell-type measuring elements and are offered for draft or pressure in minimum ranges of 0 to 0.2 in. of water and maximum ranges of 0 to 2.0 in. of water. Because of the large operating area of the liquid-sealed bell, the measuring element is exceedingly accurate and has the power to respond instantaneously to scarcely perceptible pressure changes.



The control instruments operate on the basic "Free Vane" principle of pneumatic control which Bristol has used extensively in pressure, vacuum, temperature, humidity, and flow controllers for years. They are equipped with the "Ampliset" sensitivity adjustment for synchronizing throttling range with process lag.

Instruments of this series are compact and self-contained in a 12-in. case. The whole instrument can be easily carried under the arm. Low-Range Model D40M recorders and controllers are offered for wall and flush panel mounting.

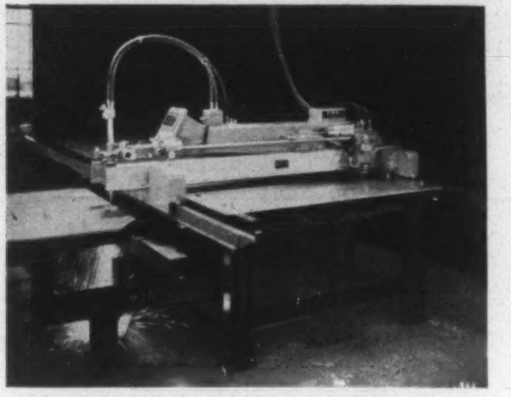
The Lea String Brush

The Lea Mfg. Co., Waterbury, Conn., has developed a type of brush known as the "Lea String Brush" for use in conjunction with the Lea method of metal finishing. In the past it has been necessary to use cloth buffs for producing satin and Butler finishes by the Lea method. With this development articles having contours and ornamentations can be even more quickly and more economically finished by the Lea method, using the new Lea String Brush. This brush is more pliable than a cloth buffing wheel and therefore permits the flexible surface when coated with Lea compound to get into the various contours of many intricately shaped articles. With the Lea String Brush, finishes can be produced ranging from a very dull satin to a bright Butler.

Oxweld Shape Cutting Machine

Introduction of the new "Oxweld Type CM-12" Shape Cutting Machine by The Linde Air Products Co., New York, makes available to the metal-working industries a machine designed to give the accuracy and range of work demanded more and more of the flame cutting processes. Its precision, simplicity and economy of operation will widen the scope of shape cutting.

The flexibility of this machine allows for almost limitless possibilities for its use. It is more powerful and has a greater cutting capacity than any other machine in its class. Any shape, from the simplest to the most complicated, can be accurately produced either automatically with templets or guided by hand. The immediate transfer of motion from one end of the machine to the other is a factor in assuring precision in all cutting operations.



In addition to cutting shapes of all description, the machine will cut straight lines automatically in any direction and at any bevel. Cuts as long as 144 in. are possible and an important feature lies in the fact that straight line cuts can be made at any desired angle in the horizontal plane. A special circle cutting attachment is also provided, thus enabling the automatic production of circles from 2 to 24 in. in radius. Still another feature is that of multiple cutting. The apparatus is designed to carry from 2 to 5 blowpipes which can perform multiple cutting operations under all the conditions possible with a single blowpipe.

The features of design and construction which makes possible the accomplishments of this new shape cutting machine typify the trend in modern machine development. Alloys have been utilized to establish an ideal strength-weight ratio combined with the necessary stability and rigidity of construction. Complete enclosure of the vital working parts insures correct lubrication and freedom from maintenance. The motor, rated at 1/3 h.p., produces a driving force reliable under all conditions. The speed range of the CM-12 is from 1½ to 75 in. per min.

Plating Solution Control

It is announced by the Grasselli Chemical Co., Cleveland, that it is in a position to offer the trade test kits for the control of cadmium and zinc plating solutions. Three kits have been developed for this purpose:

1. For the determination of cadmium in cadmium-cyanide plating solutions.
2. For the determination of zinc in alkali-cyanide or acid-zinc plating solutions.
3. For the determination of the total sodium-cyanide content in zinc or cadmium plating solutions.

As nearly all previous methods of determining these constituents were either inaccurate, unreliable or intolerably slow, the company sought to develop a method that would be an accurate, reliable and quick means of finding the concentration of these constituents in the plating bath.

It is stated that these test sets are easy to manipulate. In organizations where centralized laboratory control is available, it has been ascertained that the plater finds these test kits of great value, especially when the information they can give is required in a brief period of time.

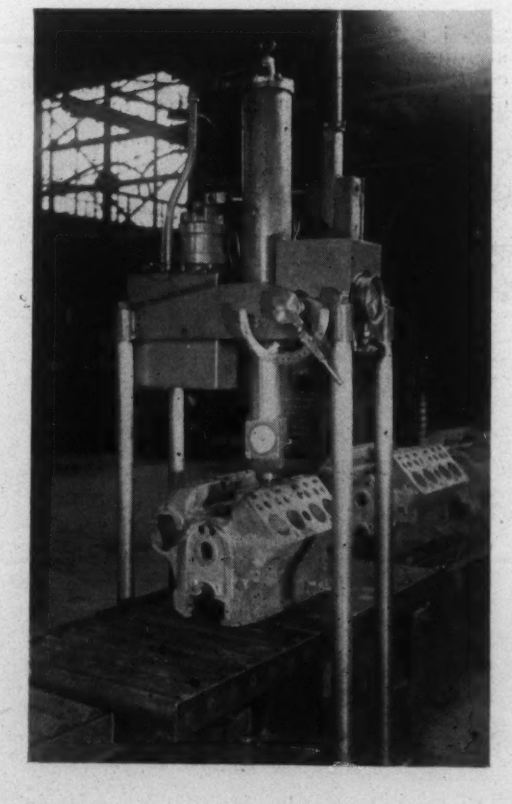
These test sets for solution control supplement the Hull and Strausser test sets announced by Grasselli a few months ago for determining the thickness of electrodeposited cadmium or zinc coatings.

There is an increasing demand for coatings of specified thickness. These developments make it convenient for the plater to determine the composition of his plating bath and in that way keep it in the most efficient condition, enabling him to apply the specified coating thickness of cadmium or zinc in the minimum plating time.

Direct Reading Conveyor Brinell

This machine is developed by the Detroit Testing Machine Co., Detroit, for testing cylinder blocks, cylinder heads, die blocks, etc., on a conveyor without elevating them to the testing position. The ram, being the moving member, has a travel of 24 inches. It is operated in the same manner as that of a steam hammer and may be held at a height to accommodate the size of blocks on production. The conveyor section is spring mounted, which permits the blocks to set on a solid support when the load is applied.

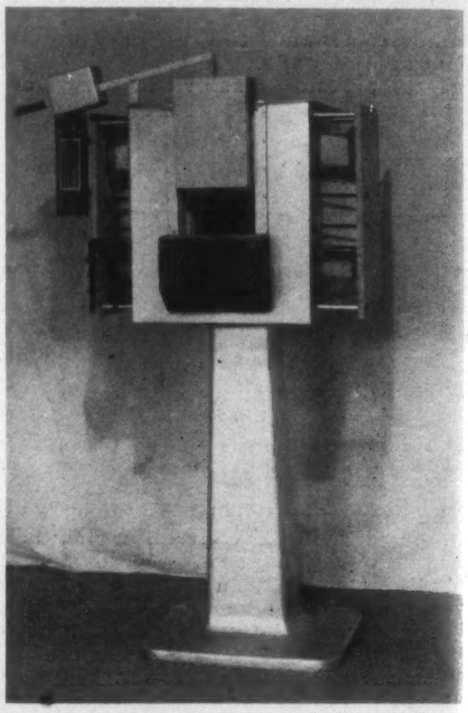
The direct reading device is the same as in the company's standard Brinell power machines and is mechanical throughout. Tests can be made without grinding or spotting and the use of a microscope. After tolerance bands are set to the desired limits, the operator merely notes that the indicator pointer stops within them. Since the actual test made is the standard Brinell, accuracy may be conveniently checked with a microscope.



Oil is used as a pressure medium assuring thorough lubrication and long life. This oil is kept at a constant temperature with a thermostatically controlled heating element and is not subject to viscosity changes, due to varying temperatures. The machine is simple in construction, easy to operate and accurate in performance.

Furnace for Hardening High Speed Steel

About a year ago the Sentry Co., Foxboro, Mass., announced its new small furnace for hardening high speed steel. This size, No. 1, Model "Y" furnace, for the first time offered outstanding advantages of quality, reliability, and economy, and created a demand for a larger size furnace of the same style. The company is now introducing size No. 2, Model "Y", furnace. Like its smaller predecessor, size No. 2 is a muffle furnace with four heating elements, two above and two below the muffle. It employs air-cooled terminals which eliminate complicated cooling water connections and will give several years' service without attention. Terminals and all electrical contacts are shielded and heating elements give well over 1000 hrs. service.



The No. 2 "Y" will heat from cold to 2350 deg. F. in 70 min. The current consumption at 2350 deg. F. is between 4½ and 9 kw. depending on the amount of work hardened. The furnace is adequately insulated and power costs are extremely low as indicated above. The furnace is designed especially to secure the full advantages of the Sentry "Diamond Block Method" of atmospheric control and has a muffle chamber 4½ in. wide, 4 in. high by 11 in. deep and will accommodate the five standard Diamond Block sizes. The furnace can be supplied with any standard make of temperature control or connected to suitable control equipment. It can be supplied either with pedestal or for bench mounting and can also be equipped with a gas curtain.

A Castable Refractory

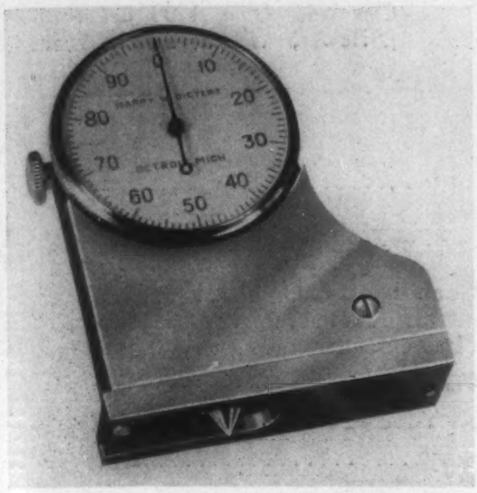
"Cast-Refract" is a time and labor-saving castable refractory, marketed by the Quigley Co., New York. It is handled like concrete, and can be cast into any desired shape or form. It is invaluable for casting special refractory shapes needed in a hurry (ready to use in 24 hrs.) and has many other uses—including monolithic furnace linings, boiler door arches and jambs, furnace door linings, etc. Its convenience and adaptability are features of wide appeal to engineers concerned with furnace operation and maintenance.

The recommended service temperature limit of this product is 2600 deg. F., within which it possesses excellent general refractory properties: A strength, freedom from shrinkage, low permeability, and outstanding resistance to spalling.

Core Hardness Tester

The surface hardness of cores and dried molds may be quickly measured with this instrument, built by Harry W. Dietsch Co., Detroit. Its net weight is 9 oz.; shipping weight, 18 oz.; height, 3 in.; and width, ¾ in.

The Core Hardness Tester is a practical tool and may be carried around without inconvenience by foundrymen.



The hardness of a core may be determined within a few seconds. A test is made by grasping the tester with the right hand and pressing it against the surface to be tested. Slowly pull the tester across the face of surface to be tested. Hardness of surface is indicated on dial.

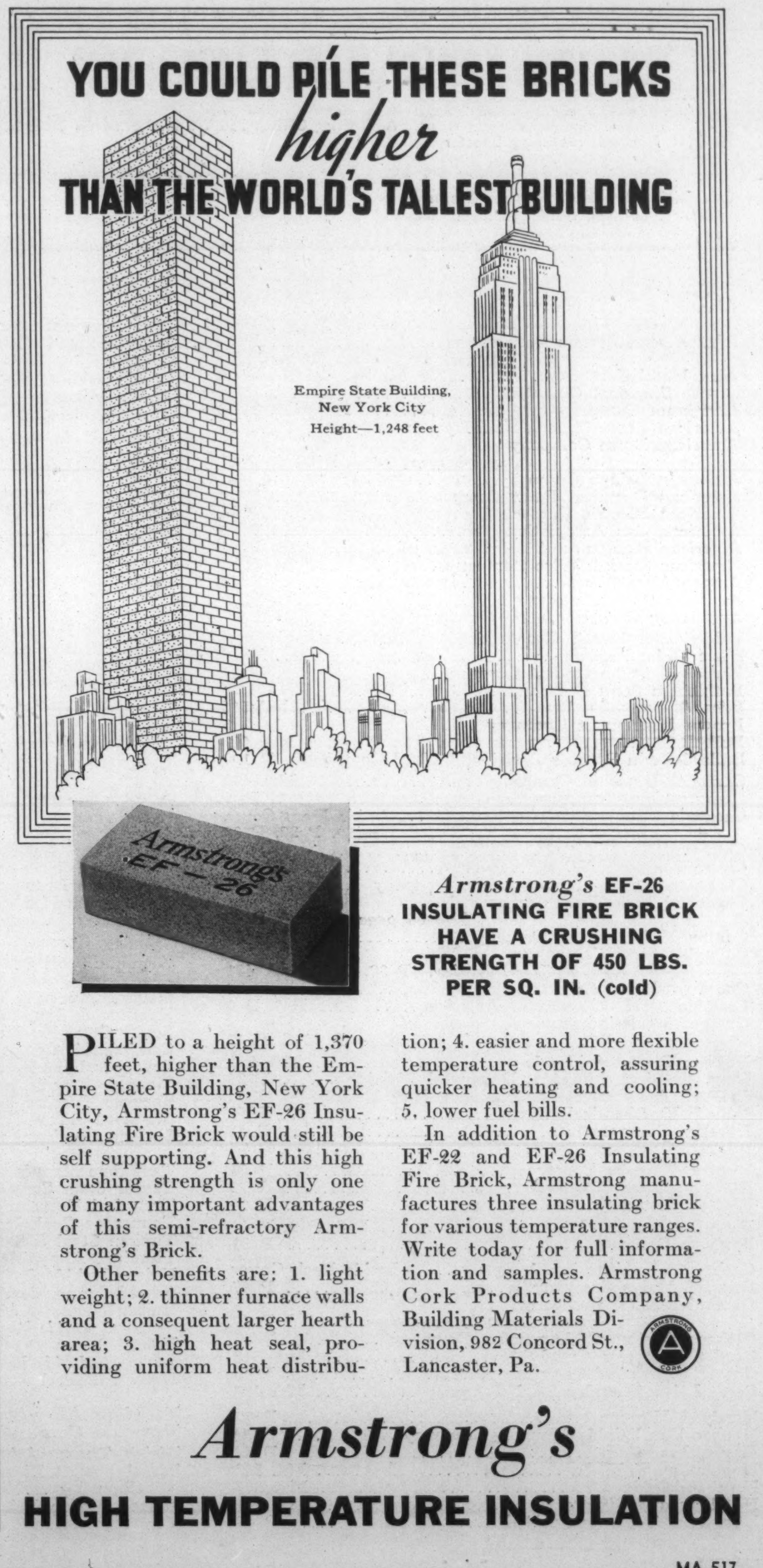
The principle of this tester is similar to the finger nail scratch test that a foundryman uses to estimate the hardness of cores and dried molds. The difference between the finger nail test and the core hardness tester is that the hardness of surface is accurately determined with the core hardness tester and expressed in numerical figures that may be recorded for definite comparative purposes.

* * *

Oil Immersed Float Switch

Designed for indoors and out in corrosive or hazardous areas, the new "Rowan Oil Immersed Float Switch" adequately answers the recognized need for such a switch on sump pumps, tanks, etc., in coke plants, blast furnaces and steel mills.

Ruggedly constructed to withstand hard usage, all operating parts readily accessible for inspection, positive action, completely oil immersed, this new Rowan float switch is claimed to provide the ideal answer to the float switch problem.



Armstrong's **EF-26 INSULATING FIRE BRICK HAVE A CRUSHING STRENGTH OF 450 LBS. PER SQ. IN. (cold)**

PILED to a height of 1,370 feet, higher than the Empire State Building, New York City, Armstrong's EF-26 Insulating Fire Brick would still be self supporting. And this high crushing strength is only one of many important advantages of this semi-refractory Armstrong's Brick.

Other benefits are: 1. light weight; 2. thinner furnace walls and a consequent larger hearth area; 3. high heat seal, providing uniform heat distribution; 4. easier and more flexible temperature control, assuring quicker heating and cooling; 5. lower fuel bills.

In addition to Armstrong's EF-22 and EF-26 Insulating Fire Brick, Armstrong manufactures three insulating brick for various temperature ranges. Write today for full information and samples. Armstrong Cork Products Company, Building Materials Division, 982 Concord St., Lancaster, Pa.

Armstrong's

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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Thirty Years of Canadian Mining. The Newer Gold Fields—I. R. C. Rowe. *Compressed Air Magazine,* Vol. 41, Jan. 1936, pages 4935-4940. Historical review of incidents and personalities in the development of the present Canadian gold mines, especially in Western Ontario and Northern Manitoba. FPP (1)

The Metalliferous Altai of Soviet Russia. I. Geology. Andrew Meyer & Edith Meyer. *Engineering & Mining Journal,* Vol. 137, June 1936, pages 275-278. Geological exploration of deposits along two tactonic zones discloses mineralization of unusual extent. A brief history and geology of the Altai mining region and a description of the mining, milling, and metallurgical practices of today. Ag, Au, Cu, Sn, and Pb have been procured from these mines. WHB (1)

The Gold Mining Industry of Western Australia. B. H. Moore. *Journal Institution of Engineers, Australia,* Vol. 8, Apr. 1936, pages 154-156. An abstract. A brief general survey of the geological conditions obtaining in the auriferous areas, the nature of the ores themselves and a general description of the methods adopted for extracting the Au from these ores. WHB (1)

Gold Mining in the Philippines. Ralph Keeler. *Compressed Air Magazine,* Vol. 41, Mar. 1936, pages 4978-4983. In 1935, 15 million dollars worth of Philippine Au was mined. Historical, economic and geographical considerations are discussed. At present there is one leaching plant in the Baguio district and several cyanidation-flotation mines. FPP (1)

Gold and Molybdenum from Rehabilitated Mines in Mammoth, Arizona. J. B. Huttl. *Engineering & Mining Journal,* Vol. 137, June 1936, pages 286-287. Descriptive. WHB (1)

Concentration of Copper-Iron Ores of Kiyalykh-Usenj District. O. A. Deminova. *Tzvetnuie Metallui,* June 1935, pages 18-36. In Russian. Describes results of concentration tests of the Cu-Fe ores of Kiyalykh-Usenz (Western Siberia). BND (1)

Weepah Gold—Modern Methods and Equipment Make Possible the Operation of an Idle Mine. T. H. Oxnam. *Engineering & Mining Journal,* Vol. 136, June 1936, pages 300-303, 306. The Au in this ore is largely in the free state, with a little Ag in a silicified gangue composed of quartz and altered country rock. The flowsheets for amalgamation and for flotation are shown. WHB (1)

Some Developments in Ore Pulp Classification. D. MacLean & C. L. Dewar. *Journal Chemical, Metallurgical & Mining Society South Africa,* Vol. 36, Feb. 1936, pages 215-216. Discussion. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 479L/9. AHE (1)

■ 1a. Crushing, Grinding & Plant Handling ■

Recent Developments at Bendigo—Favorable Results on Nell Gwynne and Deborah Lines. A. J. Moore. *Chemical Engineering & Mining Review,* Vol. 28, July 8, 1936, pages 351-354. The most important developments in Bendigo this year have been the uncovering of 2 saddle-reefs at the Monument and the reefs at the Central Nell Gwynne Syncline. Up to the beginning of this year the unsatisfactory results during the recent revival have been practically all from other types of reef. WHB (1a)

■ 1c. Flotation ■

Flotation—Application to Non-Metallics. Arthur F. Taggart. *Engineering & Mining Journal,* Vol. 137, Feb. 1936, pages 90-91. Separation of oxidized minerals by differential air levitation with oil has interesting and important commercial and industrial possibilities. WHB (1c)

1e. Amalgamation, Cyanidation & Leaching

The Precious Metals—Problems in Their Recovery. John H. Clevenger. *Engineering & Mining Journal,* Vol. 136, Feb. 1936, pages 87-89. Some difficulties are still unsurmounted in cyanidation, despite development of methods to treat refractory ores. WHB (1e)

The Addition of Lead Salts in Cyaniding Gold Ores. F. G. Macdonald & H. R. Adams. *Journal Chemical Metallurgical & Mining Society South Africa,* Vol. 36, Feb. 1936, pages 216-217. Discussion. See *Metals & Alloys,* Vol. 6, Nov. 1935, page MA 434R/5. AHE (1e)

Itogon—A Philippine Gold Producer. Ralph Keeler. *Engineering & Mining Journal,* Vol. 137, Jan. 1936, pages 3-8. An illustrated description of the mining operations at the Itogon Mining Co. where 10,000 tons of ore per month are treated by all-sliming, countercurrent cyanidation with close to 92% recovery. A flowsheet and numerous illustrations are included. WHB (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

■ 2a. Non-Ferrous ■

Ductile Chromium (Das duktile Chrom) W. Kroll. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 226, Dec. 31, 1935, pages 23-32. Examples of ductile Cr prepared by various methods are given. When 99% Cr prepared by the thermit process is distilled under high vacuum, part of the distillate is hot-forgeable to a small extent. Electrolytic Cr when heated to 1300° C. in high vacuum can be deformed and bent at dark red heat. The same metal if distilled in BeO crucible under high vacuum and remelted in A atmosphere is hot-forgeable. Cr cannot be melted under high vacuum for it sublimates before reaching its m.p.: it must be melted in A at a greater pressure. Sheets of electrolytic Cr cannot be rolled after degassing because (1) the shrinkage in volume due to escape of H_2 is coupled with tear formation, and (2) it contains too many oxide inclusions. The direct reduction of $CrCl_3$ and Cr_2O_3 with Ca in a steel bomb is described. $CrCl_3$ is obtained by chlorinating Fe-Cr, chromite or Cr and is sublimated for purification; it is only slightly hygroscopic. Ca rather than Mg or Na is preferred for reduction because of its lower b.p. The Ca was distilled twice in high vacuum. The bomb is lined with $CaCl_2$: the charge of $CrCl_3$ and 20 excess Ca is heated in high frequency furnace to 500° C., at which temperature ignition starts. The reduced Cr melts and forms pellets which can be hammered hot. Cr_2O_3 reduced with 20% excess Ca gave somewhat larger pellets with same properties but both Cr products are not commercial since they cannot be briquetted and worked to uniform rolled products. A powdered Cr of briquetable form is obtained by Marden process of Ca reduction with closed bomb in $CaCl_2$ melt, but Kroll finds a $BaCl_2$-$CaCl_2$ melt for reducing Cr_2O_3 with Ca more suitable. The process is possible in open crucible heated in high frequency furnace in A atmosphere. The product is washed with water and HCl and subjected to a second reduction to eliminate residual oxide. It can be pressed and degassed at 1300° C. in high vacuum and sintered under low A pressure at 1600°-1700° C. The product is forgeable at 1250° C. when heated in $BaCl_2$-$CaCl_2$ melt and is brittle at room temperature. K. concludes that the product will have little use because of its easy solubility in most acids. WB (2a)

Production of Low-Silica Alumina at the Volkhov Alumina Plant. M. M. Loboda. *Legkie Metallui,* Vol. 5, Jan. 1936, pages 5-10. In Russian. This plant uses bauxite containing 10-15% SiO_2. The aluminate solution, which contains about 120 g. Al_2O_3/l., is desiliconized at 150° by adding 8-10 g./l. CaO. An Al_2O_3:SiO_2 ratio of about 600-700 is obtained. HWR (2a)

The Production of Alumina at the Dnieper Aluminum Plant. V. A. Mazel. *Legkie Metallui,* Vol. 5, Mar. 1936, pages 1-15; Apr. 1936, pages 1-12. In Russian. A Ca aluminate slag is produced by fusing bauxite with coke and limestone in an electric furnace. The Al_2O_3 is extracted by digesting the crushed slag in an Na_2CO_3 solution. The recovery of Al_2O_3 depends more on the mineralogical composition of the slag than on its chemical composition. Recoveries of over 85% are obtained from all slags in the $CaO.Al_2O_3$ field if they are cooled slowly. HWR (2a)

Electrolysis of Alumina with Metallic Anodes. A. I. Belyaev & Ya. E. Studentzov. *Legkie Metallui,* Vol. 5, Mar. 1936, pages 15-24. In Russian. Anodes of Cu and of Fe plated with Ni, Cr, and Ag were used to electrolyze Al_2O_3 at 935° in an electrolyte composed of equimolecular mixture of K_3AlF_6 and Na_3AlF_6 to permit the use of a low temperature. Electrolysis proceeded satisfactorily but the anodes were rapidly destroyed. HWR (2a)

Action of Gaseous Chlorine on Sulphides, Oxides and Sulphates of Lead, Zinc, Copper, Silver and Iron in Relation to Temperature. D. M. Chizhikov & G. S. Balikhina. *Tzvetnuie Metallui,* May 1935, pages 59-77. (In Russian). The effect of gaseous Cl on sulphides (PbS, ZnS, Cu_2S, Ag_2S, Fe_2S), oxides (PbO, ZnO, CuO) and sulphates ($PbSO_4$, $ZnSO_4$, $CuSO_4$), at temperatures from 100° to 800° C. was studied. Conclusions: The sulphides of Pb, Zn and Cu are the easiest to convert into chlorides and the sulphates the most difficult. The chlorination of sulphides and oxides is easily completed at temperatures up to 700°, while the chlorination of sulphates below this temperature proceeds only very slowly. As a rule the chlorination of sulphides begins at lower temperatures than that of oxides and sulphates. With increasing temperatures the velocities of chlorination of sulphides and oxides tend to equalize. BND (2a)

Nepheline and Alunite as Raw Materials for the Aluminum Industry. M. S. Goluinskii. *Legkie Metallui,* Vol. 5, Jan. 1936, pages 37-44. In Russian. The Kandalakshe Alumina Plant, under construction in Karelia, will use nephelite. This is impractical because of high cost of fuel and limestone in that district. The possibility of using alunite in the Caucasus is discussed. $(NH_4)_2SO_4$, obtained as a by product, could be disposed of as a fertilizer. HWR (2a)

Running Miguet Furnaces. Ya. Schedrovitzki. *Metallurg,* No. 3, 1936, pages 67-76. In Russian. Information available is not sufficient to justify adding components of charge separately in preference to charging them as a mixture. Rules applicable to cost of a furnace become invalid when the same furnace is used on a different process. (2a)

2b. Ferrous

Study of Decomposition and Reduction of Siderite from Bakal Deposits. M. M. Leibovich. *Metallurg,* No. 2, 1936, pages 78-88. In Russian. Decomposition and reduction of siderite was investigated using a stream of H in an electric tube furnace. Decomposition of Ca and Mg carbonates goes simultaneously with Fe, starting at 400° C. and is practically completed at 500° C. Reduction of Fe begins ahead of carbonate decomposition. Retarded heat transfer into the interior of 1″ lumps used for the investigation shifted the temperature for complete decomposition about 100° C. upwards. Reduction of roasted siderite began at 300° C., the reaction proceeding more energetically than in raw siderite in the interval 300°-600° C., after which raw siderite is more active. At 800″ C., total reducibility of Bakal siderite ores is but slightly inferior to brown Fe ores from the same locality. (2b)

Thermodynamic Study of Phosphorus Behavior under Conditions Existing in Blast Furnace Working on High Alumina Slags. V. V. Mikhailov. *Metallurg,* No. 2, 1936, pages 72-78. In Russian. Purely theoretical calculations. $(FeO)_3P_2O_5$ is reduced by solid C beginning at 900°-950° C. In blast furnace practice when ordinary slags are used direct reduction of P begins at 1280° C.; for high alumina slags it is 1380° C. Presence of reduced Fe helps P reduction. Under normal conditions of blast furnace operation no reduction of P can be expected. (2b)

Phosphorus Reduction During Reduction of Iron Ores. A. P. Lyuban. *Metallurg,* No. 2, 1936, pages 54-72. Ca phosphate, apatite, Fe phosphate and Ag phosphates were investigated. Heating in air or N up to 1530° C. does not decompose Fe phosphates. In a stream of H reduction of Fe phosphates to Fe phosphides begins at 400° C.; reduction is practically completed in 20-30 minutes at 1200°-1300° C. Reduction with CO was considerably slower than with H_2 at temperatures below 1100° C.; above this, the speed was practically the same. Neither $Ca_3(PO_4)_2$ nor apatite react with SiO_2 and Al_2O_3 when heated in air or N up to 1470° C. Reduction by charcoal begins a little below 1000° C., apatite being more resistant than phosphate. Admixture of SiO_2 and Al_2O_3 with phosphate-charcoal mixture somewhat increases reduction. Amorphous SiO_2 and Al_2O_3 act more positively than crystalline. An atmosphere of CO and H_2 reduces Ca phosphate appreciably. At 1000° C. Ag phosphate begins to decompose in air, though only P_2O_5 is evolved. Reduction of $Ca_3(PO_4)_2$ dissolved in 45% Al_2O_3-55% CaO and 45% SiO_2-55% Ca slag kept in a crucible over Fe at 1500°-1550° C. is quite rapid, so that replacement of SiO_2 with Al_2O_3 does not have any effect on the rate of reduction observed in 10 minutes. Decomposition of phosphates can be effected in an atmosphere in which partial pressure of O is continuously reduced below a certain limit. For each temperature a definite partial pressure of P_2O_5 which is very low but has a pronounced action on reduction is established around specimens. Lowering it by reducing atmosphere accomplished the reaction. (2b)

Some Observations on Operation of a Ferro-Manganese Furnace (Quelques observations sur la marche d'un four à ferro-manganèse) Maurice Dériběré. *Journal du Four Electrique,* Vol. 45, June 1936, page 204. A sketch of conditions occurring in the hearth of such furnaces. JDG (2b)

Quality of a Casting. Casting of Natural Alloys and the Blending of Different Kinds of Cast Iron (Le Problème de la Qualité du Moulage. Le Moulage d'Alliages naturels et le Croisement des différentes Espèces de Fontes) S. S. Nekryty. *Revue de Fonderie Moderne,* Vol. 30, Mar. 25, 1936, pages 91-95. The production of special cast irons directly in the blast furnace is discusseed with particular regard to the considerable quantities of Russian Fe ores containing deoxidizing elements (Ti, V) or anticorrosive elements (Cr, Ni, Co, Cu), besides the usual elements. The possibilities of mixing different ores to obtain a desired result is discussed; with rational selection of ores, cast Fe of any desired quality can be produced directly from the ores in the blast furnace. Ha (2b)

Effect of the Nature and Efficiency of the Charge on Coke Consumption in Blast Furnaces (Influence de la Nature et du Rendement du Lit de Fusion sur la Consommation de Coke, dans les Hauts-Fourneaux) J. Lilot. *Revue Universelle des Mines,* Vol. 12, June 1936, pages 236-241. A formula is developed which connects the amount of coke required to the efficiency of the charge; the derivation of the constants in the formula is explained. If M is the amount of coke consumed per ton of cast Fe, and R the efficiency in % of the charge, then $M = 307.5 + 21{,}505/R$; R is determined as ratio of the weight of coke in per cent of the charge in minerals. For different minerals or ores the formulas are:

$M = 238 + 34{,}700/R$, for minerals with Fe in the form Fe_2O_3
$M = 339.5 + 21{,}505/R$, for minerals with Fe in the form Fe_3O_4
$M = 237 + 21{,}505/R$, for minerals with Fe in the form FeO
$M = -972 + 125.3/R$, for oxidized scrap.
$M = 65 + 14{,}385/R$ for non-oxidized scrap containing foreign matter.

A correction is given to take care of varying amounts of water and ash in the coke. The way to determine the thermal efficiency of the blast furnace is explained. Examples illustrate the application of the formulas. Ha (2b)

Hot Blast Temperature Is Controlled Automatically. G. P. Lonergan. *Steel,* Vol. 98, Mar. 30, 1936, pages 66, 68. Temperature of hot blast admitted to blast furnaces can be maintained as closely as ± 4° F. with automatic control equipment. Some benefits are smoother furnace operation; positive means of maintaining constant quality Fe, other conditions being equal; elimination of constant manual supervision; and reduction of strains and stresses set up in blow-pipes, tuyere stocks, and bristle-pipe lining as a result of fluctuating temperature. Temperature regulation is accomplished by automatic manipulation of the regular mixing-valve in the by-pass between cold-blast and hot-blast mains. Apparatus includes an electrical valve operator, a controlling pyrometer, a group of adjustable interrupters, magnetic contactors, and a manual control station for putting valve under hand control at any time. There is also a "fast opening attachment" whereby at time of stove changes, mixing-valve may be run open at full speed without waiting for controller to take command. Performance of the apparatus is outlined. MS (2b)

3. MELTING, REFINING AND CASTING

Production of Griffin Wheels at Uralsk Car Factory. P. N. Aksenov & S. E. Rosenfeld. *Liteinoe Delo,* Vol. 7, No. 4, 1936, pages 12-22. In Russian. During the first 8 months of production (1934) 18,000 (sic) wheels were cast of which 82 were passed by inspectors. Quality of production is improved somewhat at the present and the measures leading to it are described. (3)

Strickle Moulding of Large Castings. H. Fabre & H. Dubois. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 249-274. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 482. CEJ (3)

Oven-Drying of Cores and Molds. E. G. Fiegehen. *Proceedings Institute of British Foundrymen,* Vol. 27, 1933-1934, pages 169-183. See *Metals & Alloys,* Vol. 6, June 1935, page MA 222, and Vol. 5, Dec. 1934, page MA 557. CEJ (3)

The Sand Preparation Plant. G. E. France. *Iron & Steel Industry,* Vol. 9, Oct. 1935, pages 17-20. The aim of the modern sand preparation plant is to prepare a reliable and satisfactory molding sand at a minimum cost. A modern sand preparation plant is described consisting of one sand mixing mill which handles approximately 4,000 tons of facing sand per year. The labor saving is 60%; the sand consumption is reduced by approximately 1/3. CEJ (3)

Slag Control. W. Ash. *Iron & Steel Industry,* Vol. 9, Feb. 1936, pages 175-176. The functions of slag in the refining of steel are: (1) absorption and retention of the impurities of the charge, (2) control of the oxide content of the metal, (3) protection of the liquid metal from contact with the flame. These 3 functions of slag are common to both the acid and basic open-hearth processes. The manufacture of high quality steel by any process is a matter of oxide control. Acid and basic methods of control are discussed. CEJ (3)

Castings. W. Machin & M. C. Oldham. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 361-481. See *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 52L/4. CEJ (3)

Present State of Die Casting (La Fonderie sous Pression: Etat actuel). Paul Bastien. *Bulletin de l'Association Technique de Fonderie,* Vol. 10, Apr. 1936, pages 114-120. Paper presented at the 1935 International Congress of Mines, Metallurgy and Applied Geology. See *Metals & Alloys,* Vol. 7, July 1936, page MA 343L/3. WHS (3)

Refracto Fire Clay

Highly refractory and plastic—silica and alumina well balanced. Drift mined—moisture averaging but 1½% —is ideal for cupolas, ladles, blast and open hearth furnaces and rebonding molding sand. Ask about our Refractory Engineering Service.

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German Progress in Piston Rings, Brake Drums and Other Automobile Castings. W. A. Geisler. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 282-310. Standard piston rings which are not subjected to excessive stresses can be produced most advantageously by the single-ring process. For alloyed piston-rings subjected to high stresses such as those for use in Diesel engines and airplane engines, the centrifugal casting process appears to be better suited. For brake drums cast Fe is far superior to all other materials. In order to secure sufficient strength with lightness of construction a combination Fe and steel drum is used, the "Centrifuse" and "Centrit" brake drums being of this type. See also *Metals & Alloys,* Vol. 7, Feb. 1936, page MA 52L1. CEJ (3)

Products of the Foundries. Vincent C. Faulkner. *Times [London] Trade & Engineering,* Vol. 38, Dec. 1935, pages XII. Discusses foundries of the West Midlands district of England. There are 1000 establishments engaged in the production of ferrous and non-ferrous castings. Automobile section of the local foundry industry is most important of all. MS (3)

The Testing of Steel Foundry Sands and the Control of Supplies by Specification. T. R. Walker. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 614-649. See *Metals & Alloys,* Vol. 6, June 1935, page MA 222. CEJ (3)

Repairing Porous Non-Ferrous Castings by Impregnation with Bakelite Varnish. Z. I. Shneiderman. *Liteinoe Delo,* Vol. 7, No. 4, 1936, pages 25-26. In Russian. To prevent sweating of porous bronze castings, the castings were impregnated with bakelite varnish under pressure of 3.5 atmospheres, dried for 2 days at room temperature and baked 2 hours at 200° C. Castings so treated were able to withstand a hydraulic pressure of 15 atmospheres and a live steam pressure of 20 atmospheres. (3)

The Possibilities of the Electric Furnace in the Cast-Iron and Brass Foundry. A. G. Robiette. *Foundry Trade Journal,* Vol. 54, Feb. 27, 1936, pages 173-177. A paper read before the London branch Institute of British Foundrymen. It is now nearly 20 years since Elliott demonstrated by duplexing cupola metal in a basic-arc furnace, that it was possible to obtain a vastly superior product from the point of view of strength and density, by a simple refining operation. In America, and to a lesser extent in Germany, the development of the electric furnace for this purpose grew, especially with a fuller knowledge of the effects of superheating upon graphite formation, with the increasing use of expensive alloying elements, and with the realization that cheap light scrap could be utilized as one of the basic raw materials. Types of furnaces employed, melting practice, Rocking arc furnaces, semi-continuous operation, advantages of electric melting, application on the jobbing foundry, electric furnace in the mass-production foundry, electric furnace for malleable production, application of the electric furnace in the brass foundry, etc., are discussed by the author. Pig is rarely used in large proportion since one of the advantages of the electric furnace is that it can utilize cheap scrap, even borings and steel turnings, thus rendering the process economical even for irons which do not strictly come within the classification of high-duty or special irons. AIK (3)

Investigation of Parting Compounds (Beitrag zur Untersuchung von Formpuder) F. Roll. *Giesserei,* Vol. 23, May 8, 1936, pages 236-238. The properties required of a good powder to prevent the sticking of molding sand to the pattern are discussed. Vegetable powders (lycopodium), and the more generally used kieselguhr, calcium carbide, fireclay, metal oxides, were investigated; the results as to chemical composition, color, melting point, and behavior are tabulated. Ha (3)

Capillarity as a Factor in Foundry Practice. Albert M. Portevin & Paul G. Bastien. *Foundry Trade Journal,* Vol. 55, July 9, 1936, pages 28-32, 34. French exchange paper presented at the Annual Conference of the Institute of British Foundrymen in Glasgow. Discussion of the function of surface tension in the phenomena of "life" and "searching." The following principles underlying the methods of determining the surface tension are discussed: capillary height method, method employing the detachment of discs, weight of drop method, large drop or bubble method, method employing the measurement of the pressure necessary to force a bubble or drop out of the end of a capillary tube. The method of capillary waves employed by Grunmach and the method employing the oscillations of a spherical drop are also mentioned. AIK (3)

Porosity of Aluminum Die Castings. P. E. Liamin. *Liteinoe Delo,* Vol. 7, No. 4, 1936, pages 22-25. In Russian. General observations. (3)

■ 3a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Recommendations for Two Leaded Gunmetals. By the Non-Ferrous Sub-Committee of the Institute of British Foundrymen. *Metal Industry,* London, Vol. 48, June 12, 1936, pages 660-662, 664. This technical report was presented at the Glasgow Conference of the Institute and aims at the standardization of a few suitable compositions of leaded gunmetals. A lack of standard specifications has made it necessary for foundries to make gunmetal to conform to the desires of individual customers when the desired alloy differs from "Admiralty" gunmetal. For the latter, the British Standards Institution have drawn up the specification B.S.I. No. 383/1930. In a preliminary survey conducted by the Sub-Committee 37 specifications were found to be in use, the major constituents of which were within the ranges of Cu 82-93%, Sn 4-9%, Pb 0-7%, and Zn 1-8%. The Sub-Committee believes that it would be to the advantage of both producer and consumer if a few compositions were to be accepted as standard which would adequately cover the field now represented by the 37 specifications. In the survey wide variations in physical test data were found which was attributed to differences in (1) types of test bars, (2) shapes of bars, (3) methods of casting, and (4) character of the molds. It is recognized that test bars at best can give only an indication of the quality of the metal and are not truly indicative of the properties of the castings. Factors considered in the selection of the type of test bar recommended by the Sub-Committee were uniformity of results obtainable and simplicity in production. The bar recommended by the sub-Committee is made in 2 sizes, dimensioned drawings and photographs of which are included in the article. The sub-Committee recommended 2 alloys to cover the field of the 37 specifications previously mentioned. The compositions of these alloys are

	Copper %	Tin % Min.	Zinc % Max.	Lead % Max.
87:9:3:1 Gunmetal	Remainder	8	4	2
85:5:5:5 Gunmetal	Remainder	5	6	6

7 bronze foundries made series of test bars of these alloys using green sand, dry sand or both with the recommended types of test bars, casting at 1200°, 1150°, and 1100° C. The data obtained are reported for maximum stress, elongation, Brinell hardness and density for both sizes of test bars, using both dry and green sand. HBG (3a)

Lining of Bearings (Das Ausgiessen von Lagern) E. Meier. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, May 23, 1936, pages 652-654. Report of the Committee on Bearing Materials is reviewed. Possibility of replacing the imported Sn in bearing metals by domestic (German) Pb and preparation of the bearing and methods of casting the metal into the bearing bushing (to line it) with Pb alloys are described. The lining should be cooled as quickly as possible; casting should be done at 420°-540° C. The mold should be heated to 150° to 200° C. Methods for centrifugal and die casting of bushings are described. Ha (3a)

Influence of Remelting on Structure and Mechanical Properties of Stellite. I. S. Brokhin & C. Ya. Ar'eva. *Metallurg,* No. 3, 1936, pages 89-94. Stellite scrap was melted in magnesite lined crucibles and deoxidized with 0.3% of Mn and of FeSi. To take care of oxidation, 1-2% Cr, 1-2% of 80% FeW and 0.5-0.75% of 70% Fe-V were added under slag. Cast in Cu or cast Fe chills 20 x 20 mm. at 1425°-1450° C. the metal produced had the same composition as scrap and the same physical and cutting characteristics. (3a)

Phenomena in the Melting of Bronze (De Quelques Petits Phénomènes que Accompagnent la Fusion du Bronze) C. Dennery. *Bulletin de l'Association Technique de Fonderie,* Vol. 10, Mar. 1936, pages 78-89. Paper presented before the A. T. F., Mar. 17, 1936. During melting in crucible or hearth furnaces, the bronze is exposed to air and to the products of combustion, either complete or incomplete. In the electric furnace and reverberatory furnace with precombustion chamber the exposure is more limited. The gas content of the molten metal is dependent on the amounts of the gaseous elements present in the furnace, section size of the unmelted metal, the length of the heat, atmospheric moisture, surface condition of the raw material, circulation velocity of combustion gases, and pressure inside the furnace. Effects of H_2, O_2, $H_2 + O_2$, CO and CO_2 are discussed. Different reducing agents and physical or mechanical purification of the metal are considered at length. WHS (3a)

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LADLE FLUXES FOR CAST IRON

SPECIAL FLUXES FOR SPECIAL ALLOYS

THE MALUMINUM COMPANY TRANSPORTATION BUILDING INDIANAPOLIS, IND.

Chill Casting Aluminum Alloys. YA. A. CENTER. *Metallurg*, No. 2, 1936, pages 101-104. In Russian. Complicated molds for forming rubber shoes can be cast satisfactorily in chills using Al-Si alloy of eutectic composition, a temperature between 680° and 720° and chills preheated to 350°-400° C. (3a)

Casting of Bronze Manipulators Subjected to 30 Atmospheres Hydraulic Testing. Z. S. LAVUT. *Liteinoe Delo*, Vol. 7, No. 5, 1936, pages 36-37. In Russian. Discussion of casting and molding practice. (3a)

Casting Aluminum Alloy Trough 5300 mm. Long. K. P. LEBEDEV. *Liteinoe Delo*, Vol. 7, No. 4, 1936, pages 26-27. In Russian. Discussion of moulding and pouring practice. (3a)

Sand Problems in a Brass Foundry. F. HOWITT. *Proceedings Institute of British Foundrymen*, Vol. 28, 1934-1935, pages 90-114. See *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 484. CEJ (3a)

Porosity in Non-ferrous Metal Castings. G. L. BAILEY. *Proceedings Institute of British Foundrymen*, Vol. 27, 1933-1934, pages 522-542. See *Metals & Alloys*, Vol. 5, July 1934, page MA 315. CEJ (3a)

Using up Aluminum Scrap (Zum Problem der Aufarbeitung von Aluminium-Altmaterial) W. GUERTLER. *Aluminium*, Vol. 18, June, 1936, pages 256-261. The difference in the remelting practice between heavy metals and Al due to the much greater reactivity of the latter with air, gases, containers, is pointed out and it is shown how Al scrap is conveniently used again by properly sorting the scrap according to composition and melting only similar kinds of scrap together with or without other metallic additions to produce an Al alloy of definite character. An installation is described in which scrap is systematically recovered and worked over and which has proved to operate economically. Ha (3a)

■ 3b. Ferrous ■

C. H. HERTY, SECTION EDITOR

Ford's New Facilities for Casting Alloy Steels. *Iron Age*, Vol. 137, Apr. 30, 1936, pages 2-25. Describes new plant for casting of crankshaft and camshaft which were formerly forged at the plant of Ford Motor Co. The new electric furnaces are of top-charge type. All operations of furnace are protected by sequence movement interlocks. A number of vertical continuous core ovens have been installed for baking cores and paste drying. Several types of alloy cast steel parts are also made in this foundry. Gives analysis of steels used. VSP (3b)

Production of Steel Castings. *Foundry Trade Journal*, Vol. 54, Feb. 20, 1936, pages 155, 160. The principal factors in production of steel castings such as shrinkage and application of chills are considered. It is pointed out that experiments by Benedicks and calculations made by Honda show that steel passing from the liquid to solid phase contracts about 5.5% of its volume. According to T. M. Service solid steel weighs 490 lbs./ft.^{3}, whereas liquid steel weighs only 437 lbs./ft.^{3} which is equal to a change in specific gravity of from 7.85 to 7.00. Therefore, to obtain 1 ft.^{3} of solid steel 1.12 ft.^{3} of fluid steel will be required, or a total shrinkage of 10.72% takes place from 1500° C. to room temperature. The simplest form of steel casting is the tapered ingot, cast wide-end up. As far as possible, a steel casting should be made with the heavier sections above the light ones. Where it is not practicable to feed isolated heavy sections from risers, chills are applied. Because of the difficulty of estimating the amount of chilling required, the use of chills is always a very uncertain measure, and there is always a possibility of causing cracks, one of the particular defects chills are used to eliminate. AIK (3b)

The Whifflet Foundry of R. B. Tennent, Limited. *Foundry Trade Journal*, Vol. 54, Feb. 20, 1936, pages 153, 154. The present output of the works covers the complete range of roll requirements, including cast Fe grain rolls, cast Fe chilled rolls, steel rolls of all qualities, and Pilger rolls for tube mills. The melting plant comprises 4 reverberatory furnaces of melting capacities ranging from 25 to 35 tons. The furnaces are coal fired. The question of firing with pulverized fuel was carefully considered, but was rejected as an unsound commercial proposition with Scottish coals. The 3-ton cupolas are installed, and are blown by Roots blowers. There is also a 50-ton open-hearth furnace. It has a removable roof which enables heavy scrap, sometimes in sizes up to 15 tons, to be charged direct on to the hearth. At the present time Whifflet foundry has an arrangement with the Macintosh-Hemphill company of the United States for the manufacture of "Adamite" rolls. Broadly speaking, the "Adamite" alloy is made in 2 forms, i.e., as a steel base and as a cast Fe base alloy. The steel-base "Adamite" rolls have the whole of the C content in the combined form, with a sceleroscope hardness number ranging from 32 to 55, this hardness being substantially constant throughout the mass. In all cases (steel or cast Fe base) the alloys have the same low P content, and have Cr and Ni as the main alloying elements. They differ in regard to Si and C content, and, in the steel-base varieties, as regards their melting and subsequent heat-treatment. There is a decidedly important difference structurally between the "Adamite" Fe base alloy chilled roll and the ordinary chilled cast Fe roll. In the first-named there is no noticeable line of demarkation between the hard outer surface and the body of the metal, from which it is evident that the diminution of hardness is very gradual, thus adding to the wear-resisting qualities of the roll. It is claimed that the "Adamite" chilled roll, despite its hard internal structure, is at least 30% stronger than ordinary cast Fe chilled rolls. AIK (3b)

Auto Pistons Cast Horizontally. *Foundry*, Vol. 64, Apr. 1936, pages 50-51, 98, 103. Describes equipment and method used in producing alloy steel, light weight pistons for Lincoln-Zephyr car by the Ford Motor Co. Pistons are poured in horizontal position in all green sand molds. Green sand for securing a fine degree of accuracy is rammed harder than usual for green sand practice. Metal used has composition: C 1.35-1.70%; Si 0.90-1.30%; S 0.08% max.; P 0.10% max.; Mn 0.60-1.00%; Cu 2.50-3.00%; Cr 0.15-0.20%. VSP (3b)

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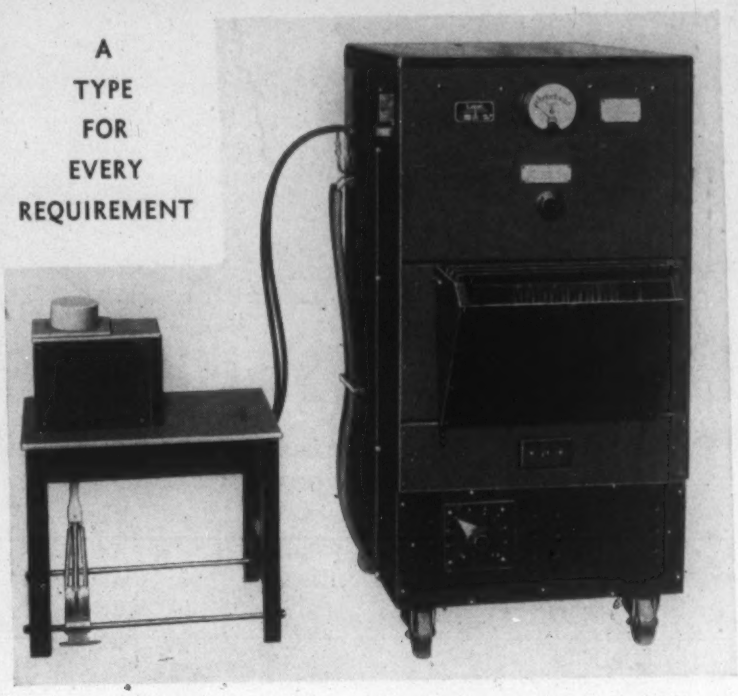

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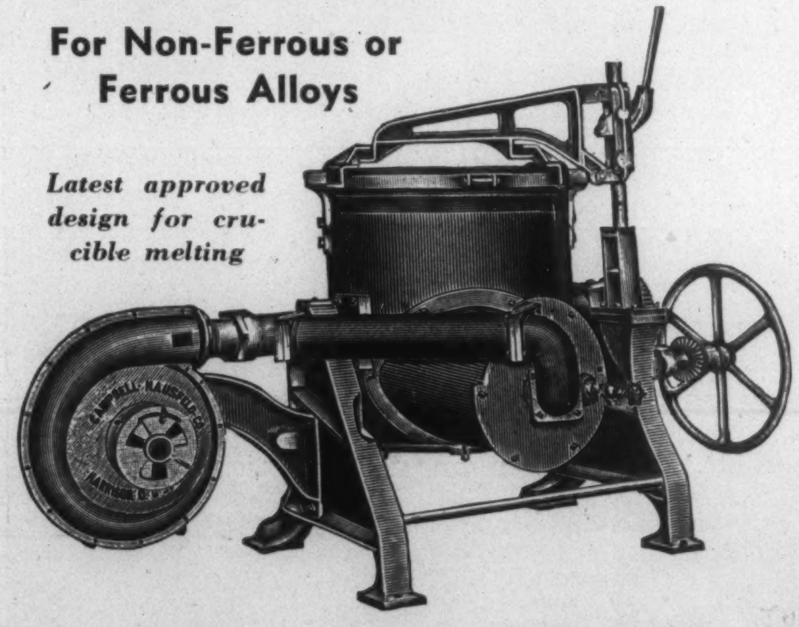

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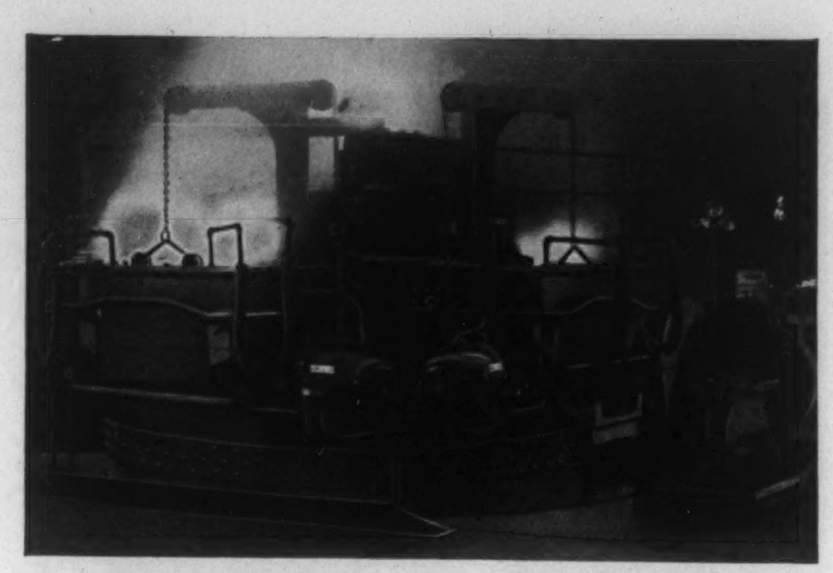

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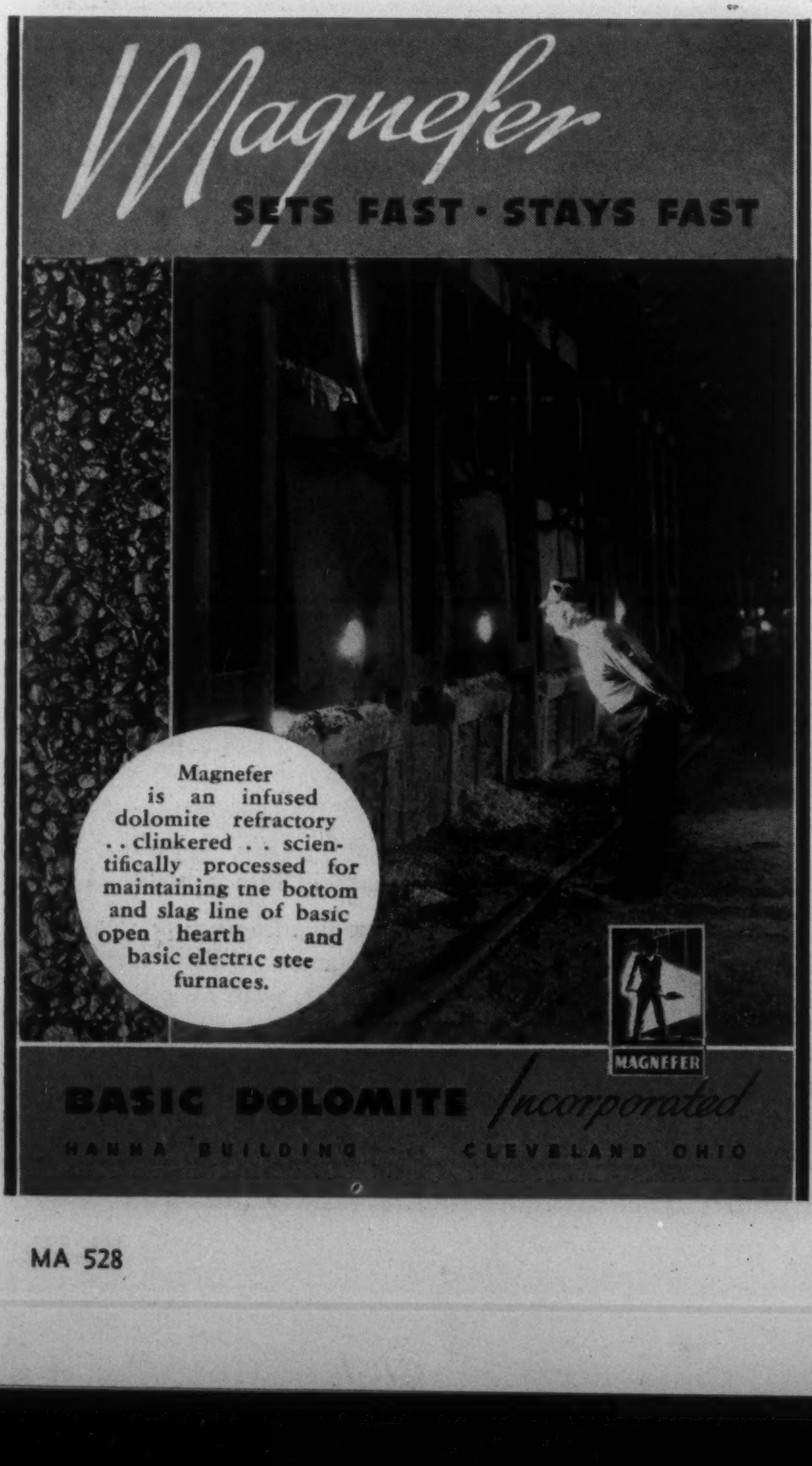

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Metal Moulds for Cast Iron. J. McGrandle. *Foundry Trade Journal*, Vol. 54, Jan. 16, 1936, pages 74-76. A paper read before the Scottish branch of the Institute of British Foundrymen. The castings here dealt with, cast in cast Fe molds, are all of one type, all being air turbine rotors. The castings for these rotors vary in weight from 23 to 290 lbs. as cast. There are 6 different sizes, all in the form of hollow cylinders. The thickness of section of the castings varies from 1½″ in the smallest size casting to 4½″ in the largest size, the outside diameters of the smallest and largest being 5½″ and 13½″ respectively, and the inside bores from 2½″ to 4½″. The castings made in cast Fe molds are run from the ordinary 2% Si metal. The molds are made from an ordinary 2% Si Fe of the following approximate analysis:—Tot. C, 3.5-3.6; Mn, 0.6-0.8; S, 0.05-0.06, and P 0.4-0.6%. This analysis is also used for the rotor castings. Metal mold design, life of molds, coatings of molds, soundness of castings, microstructure, etc., are discussed by the author. The large recessed mold has shortest life, averaging from 90 to 100 coatings per mold. In the medium size, that is, those having a mold thickness of 2½″, a thickness of casting of 2⅞″ and the centre diameter of 3″, about 250 to 350 castings are made before mold is scrapped. At the present time a thin ordinary blackwash coating is used which, whether necessary or not, is removed, and the mold is recoated each day. From the point of view of cavities of any description the soundness is practically 100% perfect. AIK (3b)

Equilibrium of Dissolved Carbon in Liquid Iron and a Gas Containing CO or CO_2 (Om jämvikten mellan kol, löst i smält järn, och en gas, innehållande koloxid och koldioxid) G. Phragmen. *Jernkontorets Annaler*, Vol. 120, Apr. 1936, pages 184-189. Author concludes that the thermodynamic activity of C is lower than that calculated on the assumption that it is proportional to the molar concentration. HCD (3b)

Study of Viscosity of Production Blast Furnace Slags. N. V. Rulla. *Domez*, No. 10, 1935, pages 18-27. In Russian. Detailed description of an improved McCaffery viscosimeter (see "Research on Blast Furnace Slags," *Metals & Alloys*, Vol. 2, Apr. 1931, page 91) sensitive to less than one poise. Theoretical consideration on which the operation of similar viscosimeters is based and their calibration is given. Operating procedure used in operation with blast furnace and synthetic slags is described. Data obtained and conclusions are left for a subsequent publication. 31 references. (3b)

Open Hearth Furnace Operation, Four Million B.t.u. per Ton. E. H. Schwartz. *Iron & Steel Engineer*, Vol. 13, Jan. 1936, pages 1-8. Paper presented and discussed at A. I. & S. E. E. Convention, Pittsburgh, Sept. 1935. Describes the use of regenerated mixture of coke oven and blast furnace gases as open hearth fuel. Gas is heated to 2150° F. and air to 1850° F. A highly luminous flame results that hugs the bath making for efficient heat transfer by radiation. 4,000,000 B.t.u./ton fuel consumption bears this out. Open hearth fuel consumption is continuous as is the production of these gases which makes their use efficient. Leakage of regenerated gas is very noticeable leading to remedial measures while air infiltration is less obvious and apt to be disregarded though the attendant losses are heavy. Regenerated gas gives an efficient luminous flame right at the port; whereas other fuels do not produce a luminous flame until they reach well into the furnace. WLC (3b)

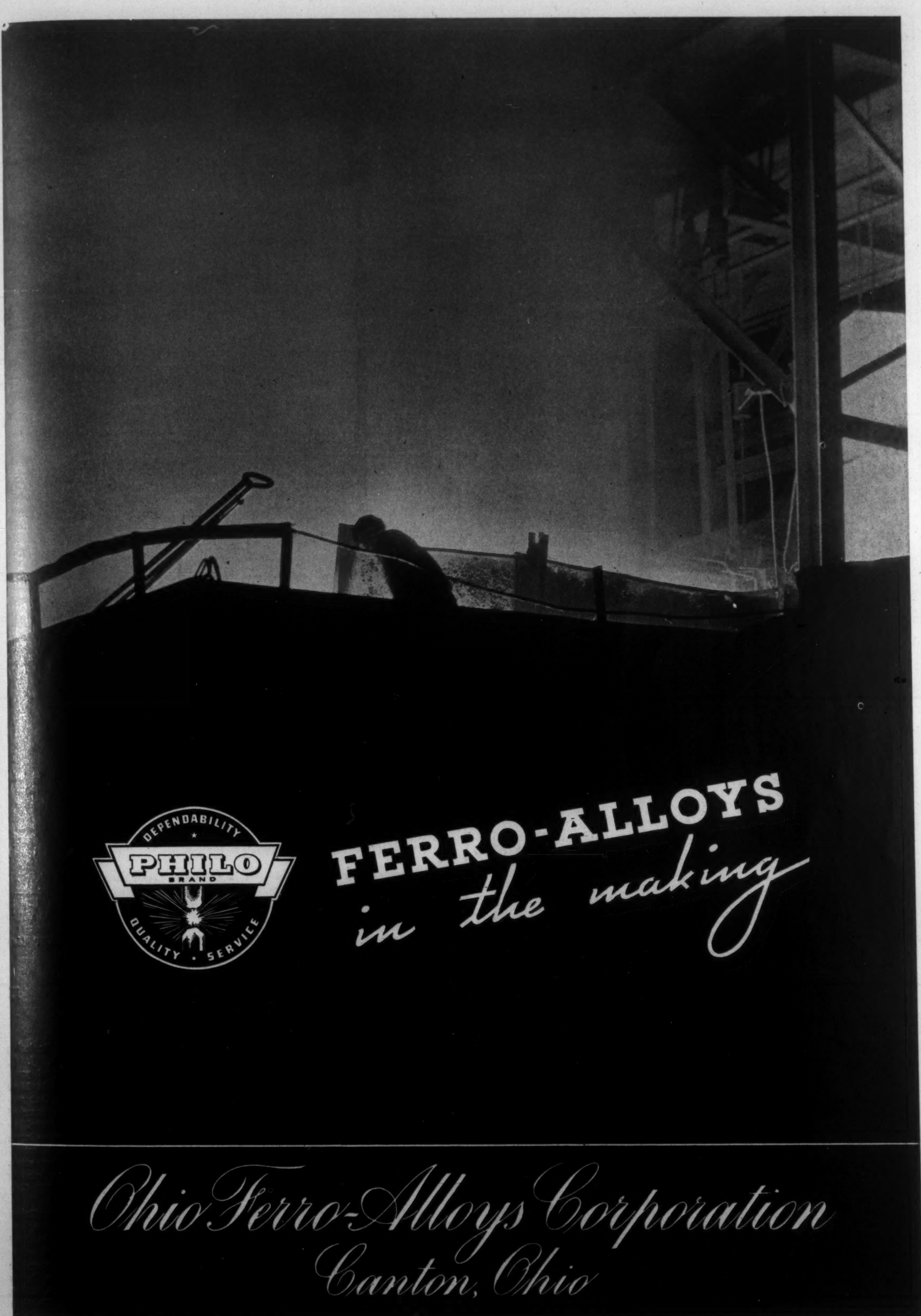
Adding Ferroalloys in the Cupola. E. K. Smith & H. C. Auferhaar. *Transactions American Foundrymen's Association*, Vol. 7, Feb. 1936, pages 313-320. The use of briquetted ferroalloys for cupola mixtures was first developed in Europe about the time of the World War. The briquets used today are made of crushed ferroalloy with a binder of suitable cement. Briquets are used extensively for high-strength or alloyed irons, or where it is desirable to increase the percentage of scrap in the charge. Several typical mixtures for various types of castings are presented. Physical properties of irons from these mixtures are listed. CEJ (3b)

Casting Gray Iron under Pressure in Metal Molds. L. M. Waite. *Iron Age*, Vol. 137, Apr. 30, 1936, pages 30-32. Describes results obtained by the Wetherill Engineering Co. in casting of gray Fe under pressure in metal molds or in sand. VSP (3b)

The Pouring of Molten Steel, Efforts Made to Produce Sound Ingots. J. D. Walters & E. G. Hill. *Iron & Steel Engineer*, Vol. 13, Feb. 1936, pages 14-18. Paper presented and discussed at A. I. & S. E. E. Convention, Pittsburgh, Sept. 1935. Discussion of various aspects of open hearth pit practice. WLC (3b)

Making Steel using Chromium Bearing Charge. N. N. Inshakov. *Domez*, No. 10, 1935, pages 28-33. In Russian. 10 heats were made in a 7 ton basic open hearth furnace using Cr bearing pig Fe in charge. The results of 2 heats are reported in detail. At the time of melting down the bath contained 1.5-2.0% Cr and 0.32% Ni. Amount of non-metallic inclusions was larger than in C heats but was within permissible limits. Distribution of inclusions was normal. Originally some $FeO.Cr_2O_3$ is formed, but all inclusions of the finished steel are composed of silicates alone. Evidence of Steinberg and Gutermann. (*Uralskaya Metallurgia*, No. 4-5, 1934, pages 34-42) regarding solubility of Cr oxides in molten steel is supported. Cr can be present in liquid steel as CrO in solution or as either Cr_2O_3 or $FeO.Cr_2O_3$ which are dispersed in it in solid state. Steel can be freed from CrO by deoxidation. At finishing temperatures when Cr content of the metal is under 0.2-0.3% dissociation pressure of CrO is greater than that of FeO so that Fe will reduce it; above 0.3% the reaction is reversed. Fe-Mn is not suitable for reduction of CrO, Fe-Si is recommended. Deoxidation cannot remove Cr_2O_3 from steel. The presence of Cr in the charge reduces the amount of its oxidation in melting. Cr_2O_3 can be removed only by vigorous boiling. (3b)

Modern Viewpoints on the Deoxidation of Open Hearth Steel (Nyare synpunkter på färskningsförloppet i martinungen) Bo Kalling. *Jernkontorets Annaler*, Vol. 120, Jan. 1936, pages 1-34. Summary of recent physico-chemical data and theories respecting the solubility of O in steel, the $C\text{-}CO\text{-}CO_2$ equilibria, the effect of Si and Mn in acid slags and their influence on the reaction of C and O, the physical conditions influencing release of gaseous products and the rate of deoxidation, and the O content in the bath during the process. HCD (3b)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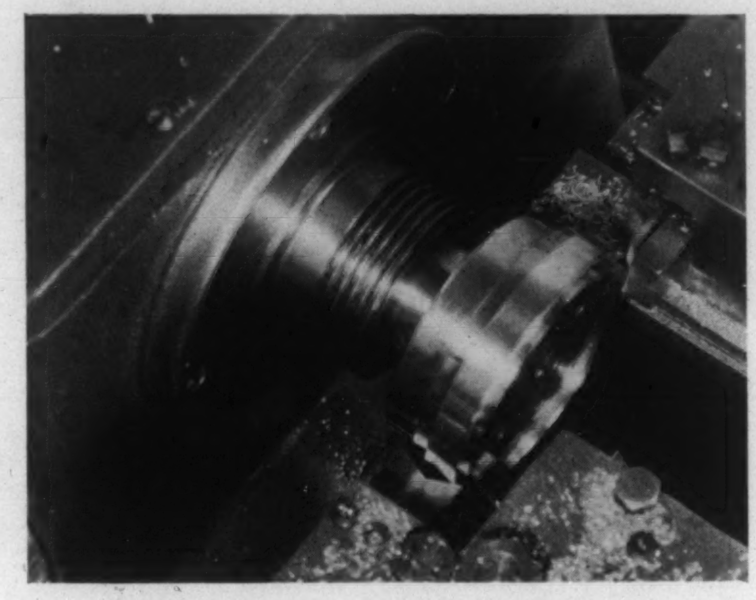

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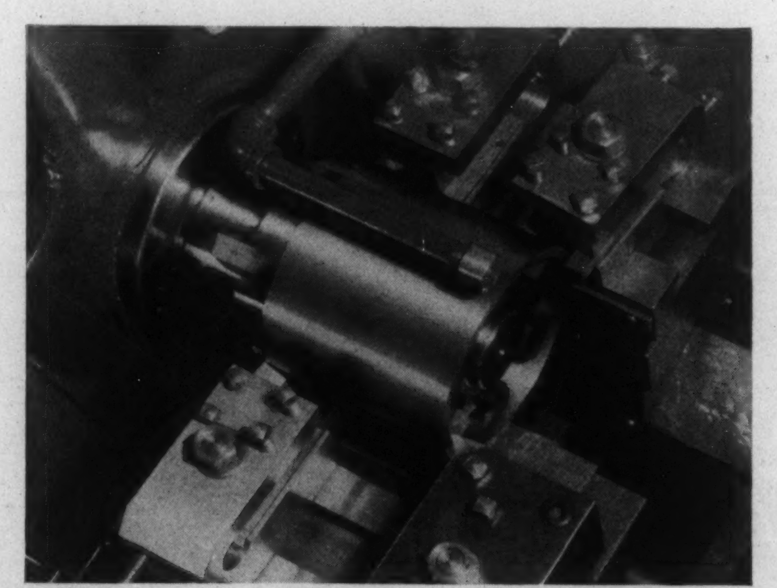

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4. WORKING

4a. Rolling

RICHARD RIMBACH, SECTION EDITOR

Large Modern Rolling Mills. Their Trend (Les Grands Laminoirs Modernes. Leurs tendances) PIERRE DEVAUX. *La Revue Industrielle,* Vol. 66, Apr. 1936, pages 137-141. Stripping of ingots is now always done by a traveling crane. Progress has been made in heating furnaces as to temperature control and oxidization loss reduction. Horizontal furnaces with hydraulic cylinder pushers are more generally used. Problems met in French rolling mill plants are quite different from those encountered in America and Germany; in France rolling mills must be designed to vary the type of production according to need. Last section of the article is devoted to cold rolling of fine sheets from 5-7 mm. down to 0.25 mm. without annealing. Close grain of product is particularly suitable for Sn plating. FR (4a)

Bethlehem Opens New $20,000,000 Continuous Mill at Lackawanna. *Iron Age,* Vol. 138, July 2, 1936, pages 24-29, 90. Describes the new continuous strip sheet and plate mill of Bethlehem Steel Co. Mill has an annual capacity of 600,000 tons of strip, sheet and light plate. Sheets of 60″ width and 0.0625″ thickness, or of 72″ width and 0.078″ thickness can be continuously hot rolled in one heating. Cold rolled strips of 0.0125 gage and heavier will be made in widths up to $23\frac{1}{16}$″ and cold rolled sheets of 30 gage and heavier in widths of from 24 to 84″. VSP (4a)

4b. Forging & Extruding

A. W. DEMMLER, SECTION EDITOR

Hot-Formed Mechanical Springs, Manufacture and Life. ARMAND H. PEYCKE & ROBERT W. CLYNE. *Metal Progress,* Vol. 29, May 1936, pages 44-49. Equipment used for the hot forming of heavy springs is described. Data are presented on merits of quenching directly and reheating for quenching. The latter method is shown to produce best results. Corrosion is a serious hazard to useful life when it takes place either in service or in storage before being put into service. WLC (4b)

Die Blocks, Their Manufacture and Treatment. B. POOL. *Iron & Steel Industry,* Vol. 9, June 1936, pages 388-390. Steels intended for the manufacture of die blocks must be of the highest quality and should be made by the acid open-hearth or electric furnace processes. The structure of the steel of the die block should be made thoroughly homogeneous by forging and upsetting the block in all directions. Small die blocks usually contain from .3-.5% C while larger die blocks in C steel contain from .60-.65% C. Ni-Cr and Ni-Cr-Mo alloy steels are used for heavier work and for longer life. CEJ (4b)

4c. Cold Working, including Shearing, Punching, Drawing & Stamping

Sheet Drawing. What it is and What it Should be (L'emboutissage, ce qu'il est, ce qu'il devrait être) PAUL BUSSON. *Science et Industrie (Mécanique),* Vol. 20, Mar.-Apr. 1936, pages 52-54. It is pointed out that methods in use are somewhat empirical and that investigations made on the plan proposed by Erich Siebel would lead to improvement in drawing and particularly in the deep drawing process. There is no special school in France for teaching the drawing process whereas there are 3 schools in Germany. FR (4c)

Shearing Strip at High Speed. H. H. TALBOT. *Iron Age,* Vol. 137, June 25, 1936, pages 69-71, 128. Describes the use of recently developed drum-type shears in cutting sheets from strip coming from rolls at speeds ranging from 150 to 2000 ft./min. Sheets are cut to an accuracy of $\frac{1}{32}$″ and in some cases to within ¼″ at practically any speed. Cutting speeds and ratios are controlled through a set of specially designed gears. Gives several examples. VSP (4c)

4d. Machining

H. W. GRAHAM, SECTION EDITOR

Grinding Stresses and Grinding Cracks in Hardened and Ground Oil-Hardening Tool Steels and Some Observations on the Nature of Ground Surfaces. J. G. MORRISON. *Steel,* Vol. 98, May 11, 1936, pages 68, 79. Abstract of paper before interchapter meeting of American Society for Metals at Pennsylvania State College, May 1-2. Experiments on 18-4-1 type high-speed steel indicate that prestressing tends to fade out if part is heated uniformly to 235° F. and quenched uniformly. With non-uniform heating, prestressing effects are accentuated in hardened tool. Cracked tools may not result but there is a tendency to crack because of unbalanced stresses due partly to prestressing. Dilute HNO_3 is recommended for ultimate inspection for cracks in ground surfaces. Grinding cracks can not be removed from hardened and ground high-speed steel, whereas grinding stresses may be removed entirely by redrawing at 1050° F. for 1 hr. MS (4d)

Drilling of Heat-treated Chromium-nickel Steel (Das Bohren von vergütetem Chrom-Nickel-Stahl) F. W. MÜLLER. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, June 27, 1936, pages 809-810. Drilling tests with hardened Cr-Ni steel have shown that such plates can be drilled economically and satisfactorily with twist drills. Hardness and toughness of the material over the length of the drill hole changed considerably. Feeding by hand was better than automatic feeding as the feed could thus be better adjusted to the varying hardness. Ha (4d)

5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Continuous Heat-Treatment of Steels. RICHARD SAXTON. *Sheet Metal Industries,* Vol. 10, Apr. 1936, pages 289-290. General discussion. AWM (5)

Defects in Hardened Light Metals used in Orthopedic Apparatus (Beitrag zur Kenntnis von Fehlern bei der Verarbeitung von vergüteten Leichtmetallen in der Orthopädie) A. J. STELLJES. *Aluminium,* Vol. 18, July 1936, pages 302-305. Light metals used for protheses or similar devices often show cold fractures which are due to incorrect design and to improper heat treatment. The latter should consist in annealing at 500° ± 5° C., quenching in cold water, and storing for 5 days at room temperature. Ha (5)

5a. Annealing

Stress Relief Annealing High Strength Monel Metal Plate. P. R. KOSTING. *Industrial Heating,* Vol. 3, July 1936, pages 439-442, 454. The effect of temperature and duration of annealing upon the tensile properties of high strength Monel metal was investigated. The maximum increase in yield strength was obtained in the range of 550°-600° C. irrespective of whether the plate was slightly cold rolled, or hot rolled and finished at a low temperature during manufacture. Annealing first increases and then decreases yield strengths. The effect of different sets is described at length. Ha (5a)

Heat-treating Steel Wire Rods in Coils for Bolt Stock. J. M. BROWN. *Wire & Wire Products,* Vol. 11, July 1936, pages 333, 354. Installation especially designed for a bolt manufacturing plant is described. 8 coils of 730 lbs. each are heated in a gas-fired, bell type furnace to 1400° F. and cooled under control. Ha (5a)

Strain Annealing of Non-ferrous Metals. H. M. ST. JOHN. *Sheet Metal Industries,* Vol. 10, May 1936, pages 387-388. See *Metals & Alloys,* Vol. 7, June 1936, page MA 289L/5. AWM (5a)

5b. Hardening, Quenching & Drawing

Multiple Tempering of High Speed. B. M. SUSLOV. *Metal Progress,* Vol. 29, May 1936, pages 72, 74, 88. Study of the tempering of high speed steel shows austenite-martensite transformation takes place at 400°-650° F. on cooling. Repeated tempering increases hardness, time having no effect. Increased cutting life is obtained by multiple drawing, cutter with one draw showing Rockwell C 62-64 gave 40-45 parts and one with 3 draws was C 65-67 hard and machined 80-85 parts. WLC (5b)

The Heat Treatment of Steel Rails. J. C. W. HUMFREY. *Iron & Steel Industry,* Vol. 9, Mar. 1936, pages 227-232; Apr. 1936; pages 265-267. During the present century the need for rails having not only increased strength as girders but greater resistance to wear and abrasion has been constantly increasing. 2 methods of improving the properties of rail steel are available, viz., chemically by the addition of hardening elements, or by heat treatment. Various processes for the heat treatment of rails are now in operation. The Sandberg process is used in Great Britain and the United States. The cooling must be such as not to accentuate the differences resulting from various rates of cooling between the various portions of the section and also between the exterior and interior, the thinner parts of the section and the exterior layers being considerably cooler than the thicker parts and the interior of the head. Accelerated cooling of the rail head is accomplished by the use of atomized water. The best indication of the superiority of these heat treated rails may be judged from the fact that one of the leading railways has already during the last 2 years obtained over 20,000 tons of rails treated by the Sandberg new regulated process for use on their extensive electrified system where there is particular need of a super quality rail, and are now ordering this quality exclusively for their electrified lines. CMS (5b)

Charging and Hardening of Large Quantities of Small Parts (Das Einsetzen und Härten von Massenteilen) C. ALBRECHT. *Feinmechanik & Präzision,* Vol. 44, June 1936, pages 97-99. Furnaces, quenching arrangements, temperature control and layout of installations are discussed. Ha (5b)

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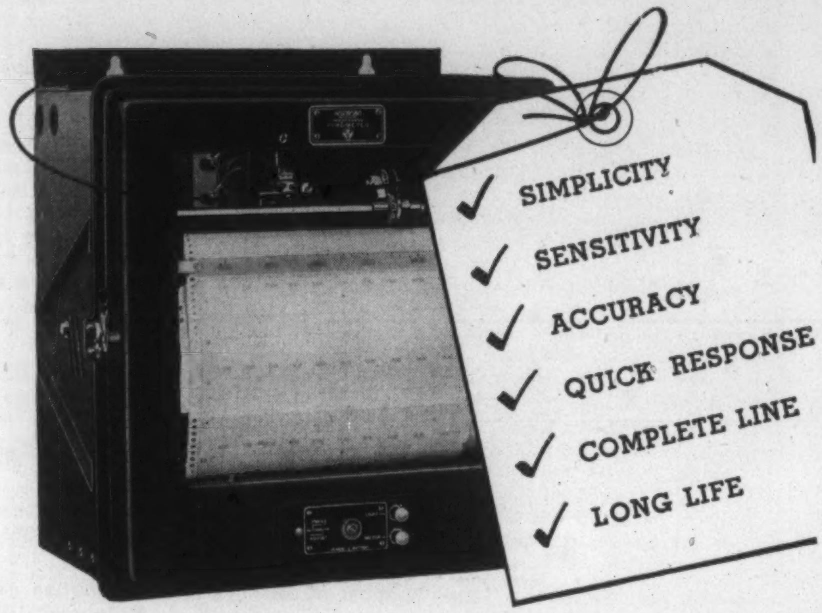

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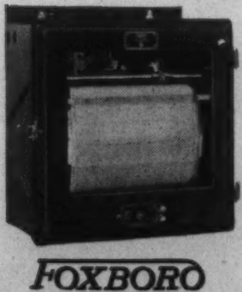

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6. FURNACES, REFRACTORIES AND FUELS . . .

M. H. MAWHINNEY, SECTION EDITOR

New Blower Reduces Hazard Involved in Cleaning Out Open-Hearth Taphole. *Steel,* Vol. 98, May 25, 1936, page 75. Blower is a conical shaped steel casting weighing 3 lbs. designed to deliver compressed air through nozzle and 8 rear jets simultaneously. With it, hole can be cleaned out clear up to furnace shell just as large as it was when closed up and without fear of a break-out, in about 1/3 time required for usual digging. Results are straighter, cleaner tapholes, 1-rod taps, and good drainage of furnace. MS (6)

New Thermocouples and Protecting Tubes. *Kachestvennaia Stal,* Vol. 4, No. 6, 1936, page 57. In Russian. Pure Ni-28-32% Cr steel thermocouples were used successfully in the plants for temperatures up to 1100°-1250° C. Their e.m.f. at 1200° C. is twice as large as of Pt: Pt-Rh and their life at this temperature is about 2-3 months. Tubes made of 28-32% Cr steel are used as protecting tubes. In usual operating conditions they last almost indefinitely while 2 to 3 months are required to destroy them at 1200°-1300° C. (6)

Boeing Aircraft Company Modernizes Heat Treating Department. *Heat Treating & Forging,* Vol. 22, July 1936, pages 351-352. **Modern Heat Treating Plant for Aircraft Steel is All-Electric.** *Steel,* Vol. 98, June 8, 1936, pages 49-50. Describes equipment installed in plant at Seattle, Wash. Includes 4 hardening and drawing furnaces; gas atmosphere controller; 3 pot furnaces; 2 oil and 1 H_2O quench tanks; and a gas muffle furnace. In addition to heat treating steel parts, equipment is used for annealing 17 and 24 ST Al alloy sheet. MS (6)

Waste-Heat Boilers in Open-Hearth Practice. *Blast Furnace and Steel Plant,* Vol. 23, Oct. 1935, pages 708-710, 719; Nov. 1935, pages 780-782, 800; Dec. 1935, pages 859-860, 862, 876; Vol. 24, Jan. 1936, pages 87-89; Feb. 1936, pages 167-169; Mar. 1936, pages 241, 247, 254; Apr. 1936, pages 344-345; May 1936, pages 424-425. From Second report of the Open-Hearth Committee of the Iron & Steel Industrial Research Council, published as Iron & Steel Institute Special Report No. 10. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 406R/3. MS (6)

Large High-frequency Electric Furnaces (Aus der Praxis mit grossen Hochfrequenzöfen) BOER. *Siemens-Zeitschrift,* Vol. 16, July 1936, pages 255-259. Recent experiences with furnaces of 6-8 tons, 500 cycles and 2300 v. are described. Construction details are given. The furnaces are lined with quartzite which is electrically sintered. Consumption for a 6 ton furnace is 1600 kw., energy consumption per ton 500-600 kw.hr., melting time for high-grade steel scrap with under 0.1% C about 2 hrs.

The Application of Fused Silica in Heating Processes. Part I. -Furnaces and Heated Enclosures. W. L. PATRICK & G. N. PEEL. *Industrial Chemist,* Vol. 12, May 1936, pages 221-226. Resumé of physical properties and a detailed discussion of methods of application in tubular, high-frequency induction and vacuum melting furnaces. RAW (6)

Refractories for Basic Open-hearth Furnaces (Refrattari per i forni Siemens-Martin basici) L. POMPEI. *La Metallurgia Italiana,* Vol. 28, Apr. 1936, pages 145-161. Requirements are outlined and the principal refractories reviewed in the light of the above requirements. AWC (6)

Principles of Theory and Design of Coreless Induction Furnaces. V. I. RUDZIK. *Metallurg,* No. 3, 1936, pages 77-89. In Russian. (6)

Electric Annealing Furnaces and their Heating Elements. W. ROHN & JOHN E. W. GINGER. *Metallurgia,* Vol. 14, May 1936, pages 7-9; *Heat Treating & Forging,* Vol. 22, June 1936, pages 299-301, 307. See *Metals & Alloys,* Vol. 7, July 1936, page MA 348R/8. JLG + MS (6)

Heating Furnaces for Hot-pressing of Aluminum Parts (Anwärmeöfen zum Warmpressen von Aluminiumteilen) K. ROBERTZ. *Aluminium,* Vol. 18, July 1936, pages 293-297. The special demands which are made on heating furnaces for Al are discussed and explained by description of installations. For small plants and if there is no particular necessity for uniformity of material simple muffle furnaces can be employed, while for good uniformity and especially for heating of previously pressed material semi-continuous furnaces are preferred in present practice. If operations are continuous, in 3 shifts per day, and particularly if large production is required in small space, continuous furnaces with vertical shafts (paternoster furnaces) are recommended. Ha (6)

Destruction of Melting-furnace Refractories by Softening and Melting (Die Zerstörung feuerfester Schmelzofensteine durch Erweichung und Schmelzen). E. T. RICHARDS. *Feuerungstechnik,* Vol. 24, May 1936, pages 73-77. 7 factors affecting the softening and melting points of furnace refactories are listed and discussed. Chemical, physical and design conditions are shown to be of greatest importance. Destruction can be minimized by (1) protection of the refractory against excessive surface pressure through appropriate arch design, and careful preparation of the refractory surface before insertion and (2) protection against contaminations that lower the melting point through attention to the porosity of the material and treatment with carefully selected pore-closing substances.

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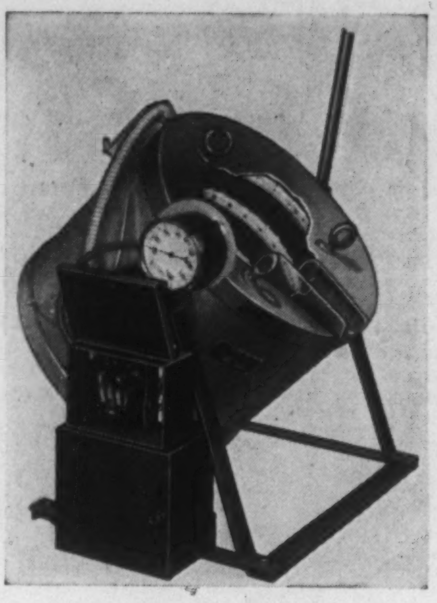

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Operation of Large-size Coreless Induction Furnaces. FRIEDRICH BARDENHEUER. *Steel*, Vol. 98, May 11, 1936, pages 46-50. Translated from *Stahl und Eisen*, Vol. 55, pages 821-825. See *Metals & Alloys*, Vol. 6, Dec. 1935, page MA 494L/8. MS (6)

Blast Furnace Design and Dimensions. M. A. PAVLOFF. *Engineering*, Vol. 142, July 24, 1936, pages 105-106. Abridged from a paper read at the International Congress of Mining, Metallurgy, and Applied Geology, Paris, Oct. 1935. See *Metals & Alloys*, Vol. 7, Apr. 1936, page MA 189L/7. VSP (6)

The Properties of Open-hearth Checker Bricks. T. SWINDEN & J. H. CHESTERS. *Iron & Coal Trades Review*, Vol. 133, July 3, 1936, page 13. Investigations of melting point, cold crushing strength, specific heat and thermal conductivity, heat capacity and diffusivity were made to determine the most suitable materials for use in the checkers of open-hearth steel-melting furnaces. It could be concluded that a strong similarity is found in such of the physical properties of fireclay and semi-silica bricks as would affect their use in open-hearth furnace checkers. Used checker bricks, provided they are unglazed and can readily be freed from dust, can be re-used without any loss in efficiency. The principal materials responsible for the corrosion of steel furnace checker bricks are Fe oxide (45%) and lime (10%); although other materials, notably Zn oxides and alkalis may be present in considerable amounts. Ha (6)

Drill Steel Tempering Furnace. W. V. DECAMP. *Engineering & Mining Journal*, Vol. 137, July 1936, page 344. An automatic lead-bath tempering furnace is described and illustrated. Features are simplicity of design and automatic operation. WHB (6)

Electric Furnace in the Gray Iron Industry. A. H. GREISSER. *Electrical West*, Vol. 76, June 1936, pages 151-156. Report of the Utilization Committee, Engineering and Operating Section, Northwest Electric Light and Power Association. Enumerates advantages of the electric furnace over the cupola for production of ordinary gray-Fe; outlines costs of operation with special reference to Pacific Northwest; gives specifications for furnaces of the direct-arc and single-phase, indirect-arc rocking types; tabulates operating results on small gray-Fe and steel furnaces; and discusses voltages and current regulation, electrodes, linings, and absorption of metal by linings. MS (6)

Some Factors Affecting the Durability of Refractories. J. F. HYSLOP. *Metal Treatment*, Vol. 2, Summer 1936, pages 86-88. The service behavior of a refractory depends on its thermal expansion, volume stability, strength under load, and its resistance to thermal shock, corrosion, abrasion, and the action of furnace atmospheres as well as on its refractoriness. JCC (6)

Wire Bakers, Past and Present. K. B. LEWIS. *Wire & Wire Products*, Vol. 11, Sept. 1936, pages 423-425. Development and present methods of indirect-fired convection-baking are discussed. Ha (6)

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Open Hearth Furnaces, Factors to be Considered in Insulation. Gilbert Soler. *Iron & Steel Engineer,* Vol. 13, Feb. 1936, pages 11-13. Discussion of the application of insulation to open hearth furnaces. Factors affecting choice of insulation, manner and place of application must be closely studied. Design, type of fuel and introduction of the insulation idea to the operating personnel are important factors in the success of insulation. WLC (6)

Coal and Its Mineral Matter with Reference to Carbonization. A. W. Gauger. *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, pages 310-312, 334; May 1936, pages 406-409; June 1936, pages 508-510. Paper presented before the Eastern States Blast Furnace & Coke Oven Association, Feb. 7, 1936. Discusses mineral matter in coal and the physics and chemistry of certain inorganic compounds of importance in both the by-product coke-oven and blast-furnace. MS (6)

Liquefied Petroleum Gases Finding New Uses in Metal Treating Plants. Martin J. Conway. *Steel,* Vol. 98, June 15, 1936, pages 34-36. Paper before National Association of Power Engineers. Discusses distribution, advantages, and uses of liquefied C_3H_8 and C_4H_{10}, gives specifications, and tabulates principal properties and combustion data. Increasing industrial applications include metal cutting, atmospheric control, particularly in bright and clean annealing and in gas carburizing, and firing of practically every general kind of heating and heat treating furnaces. MS (6)

Oven for Drying Hand Ladles. S. I. Chetvertukhin. *Liteinoe Delo,* Vol. 7, No. 6, 1936, pages 36-39. In Russian. Structural features of an efficient dryer for small ladles. Optimum temperature for drying is 280°-300° C. and the ladles should be treated in an upright position. (6)

A New Combination Color Pyrometer with Comparison Lamp (Ein neues kombiniertes Farbpyrometer mit Vergleichslampe) G. Naeser. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 18, No. 2, 1936, pages 21-25. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 406R/8. Ha (6)

Coke Saved, Hazard Reduced by Safety Blowpipe for Blast Furnaces. F. L. Prentiss. *Iron Age,* Vol. 138, Aug. 6, 1936, pages 28-30, 94. Describes the new blowpipe developed by Arthur G. McKee & Co., Cleveland, and the Michigan Steel Casting Co., Detroit. The safety blowpipe is an insulated pipe of 2 tubular members, one within the other. Inner tube is a centrifugally cast heat resisting member. Blowpipe is of simple construction and is quickly interchangeable for old type of cast Fe pipe. It is claimed to eliminate hazard of furnace operation and marked increase in efficiency by saving coke and heat at the tuyere. VSP (6)

Refractories in Metallurgical Industries. John D. Sullivan. *Journal American Ceramic Society,* Vol. 19, Aug. 1936, pages 213-233. General summary of refractory requirements and life in metallurgical industries consuming the greater amounts of refractories is given and effect of refractory developments on performance and life of furnaces is discussed. Basic open-hearth furnace refractory problems as to furnace bottoms, roofs, front and back walls, ports and bulkheads, checker chambers, tap holes, ladle linings and nozzles are detailed. Furnace operators report 10-25% increased roof life after insulation. Acid open-hearth furnace, Bessemer converter, Fe-blast furnace, heating furnaces, Fe cupola, malleable Fe air furnace are detailed as to present practice in refractories. The same is done for by-product coke ovens, Cu blast furnace, reverberatory Cu smelting furnaces, converters, Cu anode refining furnaces, wire bar, Zn distilling, continuous Zn distilling furnaces, Pb smelting, Pb refining, direct-arc furnaces with acid and basic linings, indirect-arc furnaces and induction-electric furnaces. New developments and trends in refractories reviewed. WB (6)

Automatic Control Increases Wire Galvanizing Efficiency. L. E. Smith. *Industrial Gas,* Vol. 15, Sept. 1936, pages 17-19, 23. Improvements made by new arrangement of gas burners and refractory layer at the bottom of the galvanizing kettle are described; they resulted in closer temperature control, decreased dross formation and lower maintenance costs. Ha (6)

Pouring Pit Refractories and Their Effect on Alloy Steel Quality. Edward E. Callinan. *Brick & Clay Record,* Vol. 88, June 1936, pages 229-331; *Iron Age,* Vol. 138, July 16, 1936, pages 46, 48, 114-115. From a paper read before the Ohio Ceramic Industries Association. Ladle brick nozzles, sleeves, hot tops and plugs are discussed with reference to their requirements in the production of quality alloy steel. CBJ + VSP (6)

Heat Transfer in Continuous Re-heating Furnaces. J. E. Eberhardt & H. C. Hottel. *Heat Treating & Forging,* Vol. 22, Mar. 1936, pages 144-149; Apr. 1936, pages 193-198; *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, pages 338-343, 361; May 1936, pages 419-421, 431. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 405L/5. MS (6)

Electric Furnaces and Their Part in Metallurgical Progress. Frank R. Palmer. *Yearbook American Iron & Steel Institute,* 1936, pages 93-115; discussion pages 115-124; *Iron Age,* Vol. 137, June 4, 1936, pages 32-35, 84; *Heat Treating & Forging,* Vol. 22, June 1936, pages 302-307; July 1936, pages 353-355; *Blast Furnace & Steel Plant,* Vol. 24, June 1936, pages 499-501, 507; *Steel,* Vol. 98, June 22, 1936, pages 62, 64-69. The advantages and uses of the electric furnace are discussed and data given on the production of electric alloy steel. VVK + VSP + MS (6)

Recent Developments in Open Hearth Furnace Design and Operation. L. F. Reinartz. *Yearbook American Iron & Steel Institute,* 1936, pages 122-171; discussion pages 171-184; *Iron Age,* Vol. 137, June 4, 1936, pages 36-45; *Mining & Metallurgy,* Vol. 17, June 1936, pages 296-298. Historical review of the open hearth process and suggestions for modernizing an open hearth plant. VVK + VSP (6)

Seamless Tubing Heat-treated in a Continuous Furnace. *Industrial Heating,* Vol. 3, Aug. 1936, pages 502-504. Describes an 88′ x 6′ (inside) furnace heated with natural gas of 1050 B.t.u. with a capacity of 1.83 tons/hr. Fuel consumption was remarkably low, averaging only 8.15 (sic. Probably should read 815.0) ft.^{3} gas/ton over a two months' period of continuous day and night operation. Ha (6)

7. JOINING

The Influence of Research on Welding Standardisation. *Aluminium & Non-Ferrous Review,* Vol. 1, Mar. 1936, pages 268-270. Reprinted from *The Welder.* A brief review of the field covered by existing British Standard Specifications dealing with materials, procedure, and workmanship of constructional welds. JCC (7)

7a. Soldering & Brazing

C. H. CHATFIELD, SECTION EDITOR

Joints in Tear Gas Projectiles Are Made by Electric Furnace Brazing. *Steel,* Vol. 98, Apr. 13, 1936, pages 44, 47. See *Metals & Alloys,* Vol. 7, July 1936, page MA 352R/9. MS (7a)

Some Practical Notes on Brazing Metals with Modern Alloys. A. Eyles. *Sheet Metal Industries,* Vol. 10, Apr. 1936, pages 330-332. The author discusses the use of silver solders with particular reference to "Silfos." The need for cleanliness and the regulation of heating are stressed. AWM (7a)

Soldered Joints in Aluminum Cables (Lötverbindungen in Aluminiumkabeln) G. Kramer. *Elektrotechnische Zeitschrift,* Vol. 57, June 1936, pages 675-677; *Aluminium,* Vol. 18, July 1936, pages 299-302. A soft soldering method with a reaction solder and a special flux to remove the oxide layer on the Al surface is described. Ha (7a)

Electric Brazing. A. G. Robiette. *Electrical Review,* Vol. 118, June 5, 1936, pages 816-817. Outlines principles, equipment, applications and advantages of brazing in continuous electric furnaces with controlled atmospheres. Parts to be joined are fitted within 0.001″-0.03″ and Cu or other brazing alloy is placed close to the joint. Assembly is passed into an electric furnace having an atmosphere of partially combusted coal-gas at a temperature slightly above m.p. of brazing alloy. Molten alloy flows into joint by capillarity. Flux is not normally used. Parts are cooled in a cooling chamber having same atmosphere. Several joints can be brazed at one time permitting a complicated article to be built up from a number of components, such as stampings, pressings, and small machined parts. Properly designed brazed assembly of mild steel fractures in tension at a point remote from the joint. As only the minimum of brazing alloy is required, no subsequent cleaning is necessary. Parts can be heat treated after brazing. This process is often cheaper than other joining methods. At present its widest application is to steel parts using brass or Cu as brazing alloy. Recent work indicates it has possibilities for non-ferrous metals such as brass and Ni alloys; Ag solders being used for brazing. MS (7a)

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

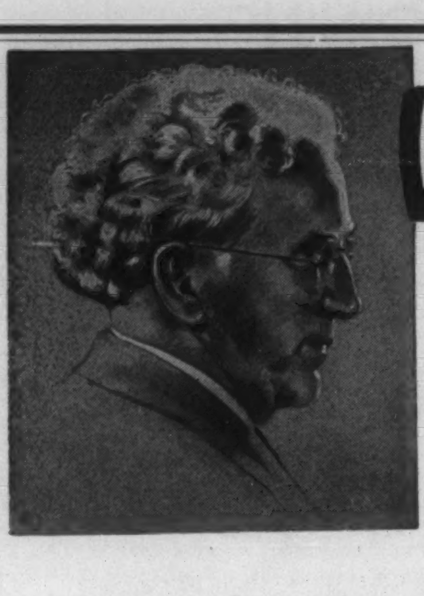
Design and Construction of Gears and Gear Cases Employing Cast and Rolled Steel Assembled by Welding. Everett Chapman. *Welding Engineer,* Vol. 21, May 1936, pages 32-37. Paper presented at Annual meeting of American Gear Manufacturers Association, Apr. 21, 1936. General discussion of joining of cast and rolled sections by welding, and metallurgical and stressed structures obtained with welds with and without preheat, etc. WB (7b)

Alloy Steels for Welded Power Piping. J. R. Dawson. *Welding Journal,* N. Y., Vol. 15, June 1936, pages 18-23. Better thermal efficiency at higher steam temperature and pressure is pointed out and most important property of steel for this service is considered to be creep strength. Creep resistance of 9% Cr steel and 18-8 is shown to be considerably higher than C steel at 900° F. Internal and external corrosion problems are best met with the alloy steels. Internal corrosion is caused by O_2 from decomposition of steam and dissolved O_2 in water. External corrosion of economizer tubes, etc. comes from S in combustion gases, H_2SO_4 in vapor at dew point, etc. Welding is of advantage in installation of piping due to more effective insulation. There is less danger of leakage than for mechanical joints and piping layout can be more compactly arranged. Properties of the low Cr, 18-8 steels are detailed and use of Cb, N_2 in steels for embrittlement resistance and grain refinement respectively is discussed. WB (7b)

What the Electric Arc Means to People of Foreign Lands. A. F. Davis. *Metal Progress,* Vol. 29, May 1936, pages 59-60. General description. WLC (7b)

The Electronic Tornado. Automatic Arc Welding (El Ciclon electronico. Soldadura al arco automatica) A. F. Davis. *Metalurgia y Construccion Mecanica,* Vol. 2, Apr. 1936, page 7; May 1936, page 5; June 1936, page 7. The development of the "electronic tornado" process, the equipment used, and its applications are discussed. FRM (7b)

Maintenance of Way Welding. C. A. Daley. *Welding Journal,* N. Y., Vol. 15, May 1936, pages 14-18. Sphere of recommended uses for arc and oxy-acetylene welding in building up battered rail ends is discussed. Procedure in reconditioning rails differs from the more economical "reforming" practice where metal is added to bring rail ends to same level and surface fusion method where rail end is preheated quickly on the surface almost to fusion temperature and new metal added. Heat treating by water quench from 1500° F. down to 300° F. and reheat to 650° F. air cool is described as practiced for rail ends built up in field. Drawing temperature is checked by testing rail end with 50-50 solder struck across heated surface. WB (7b)



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Welding in the Petroleum Industry. *Welding Journal,* London, Vol. 33, Feb. 1936, pages 46-52. A review of the following papers on welding presented at the Institution of Petroleum Technologists, Feb. 11, 1936. **The Welding of Pressure Vessels.** S. F. DOREY. Pages 46-49. Procedure reviewed for welding drums and for tests on welded material. **The Use of Welding in Transportation and Storage of Oil.** H. C. HARTLEY. Pages 49-50. Discusses pipe welding. **The Training of Electric Welders.** W. G. POOLE & R. T. ROLFE. Pages 50-52. Describes qualifying tests. WB (7b)

Resistance Welding. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page 34. Discusses limitations and possibilities of resistance welding as a production method, control and operation, and types of machines used. MS (7b)

Fabricated Machinery Developments. *Electrical Review,* Vol. 118, May 29, 1936, pages 779-780. Describes some applications of welding to the fabrication of large-scale equipment and conversion apparatus in the Edinburgh, Scotland, works of Messrs. Bruce Peebles & Co., Ltd. Use flame cutting-machines and a.-c. and d.-c. welding. MS (7b)

Welding Simplifies Manufacture of Motor Frame of Complicated Design. D. B. CHARTERS. *Welding Engineer,* Vol. 21, May 1936, pages 40-42. Details briefly given with many illustrations. WB (7b)

The Oxy-Acetylene Process, Its Use in the Iron and Steel Industry. E. J. W. EGGER. *Iron & Steel Engineer,* Vol. 13, Mar. 1936, pages 27-29. Discussion of the use of acetylene torch in cutting steel for fabrication. WLC (7b)

The Modern Trend in Arc Welding. JOHN T. EDMUNDS. *Journal South African Institution of Engineers,* Vol. 34, May 1936, pages 242-258. A review and discussion. WHB (7b)

Resistance Welding, IV, V. L. H. FROST. *Welding Engineer,* Vol. 21, Apr. 1936, page 34; May 1936, pages 47-48. iscusses electrode tips and welding of Al. WB (7b)

Welding in Aviation. CARL DE GANAHL. *Sheet Metal Industries,* Vol. 10, May 1936, pages 411-412. From a paper before the New York section of the American Welding Society. Discusses oxy-acetylene welding of Cr-Mo and spot welding of stainless steels. Brings out the action of Ti and Cb in preventing intergranular corrosion. AWM (7b)

The Present Status of Welding of Non-ferrous Metals (Der gegenwärtige Stand des Schweissens von Nichteisenmetallen) C. STIELER. *Zeitschrift Verein deutscher Ingenieure,* Vol. 8, May 23, 1936, pages 657-660. The use of welding of non-ferrous metals has increased lately largely due to development of modern welding processes, as arcatom-welding, and resistance and gas welding. Methods for welding of Cu and Cu alloys, Zn, Pb, Ni and Ni alloys, Al and Al alloys, their peculiarities and handling, are described. Fluxes and means for controlling the welding process automatically by electronic devices are discussed briefly. Ha (7b)

Influence of Electric Arc Characteristics on Nitrogen Absorption by Liquid Steel. A. A. SHATALIN. *Metallurg,* Vol. 11, June 1936, pages 19-34. In Russian. Comprehensive presentation of the theoretical aspects of the subject taken from published literature precedes description of experimental practice. A 2 kg. furnace with spherical working space was used. Temperature measurements could not be made accurately. Analysis showed that electric arc induces N absorption, greatest influence being exerted by the portion of arc close to metal. Lengthening of arc with a constant power increases N absorption up to a certain point after which further lengthening does not have any effect, other factors being constant. In electric welding this point is never reached so that with changing length of arc N absorption capacity of the weld varies. In arc furnaces this point is always passed so that N content of steel does not depend on the length of arc, provided power is constant. (7b)

Radiography of Welds (Technique de la Radiométallographie des Soudures) ROBERT SCHMIDT. *Bulletin de la Société des Ingénieurs-Soudeurs,* Vol. 7, Jan.-Feb. 1936, pages 2069-2082. Lecture before the French Welders' Society. Gives characteristics of X and gamma rays and of radiography apparatus. Radiography has shown what added metals to use in order to reduce porosity in welds and to establish best practice for making sound welding joints. When defects are found it is easy to eliminate them by correct repair work. Radiographs of sound welds show the user of products what he can get with welding process when correctly made and controlled. FR (7b)

Repairs of Fractured Cast Engine Parts and Replacement with Wrought Iron by Acetylene Welding (Instandsetzungsarbeiten an gebrochenen Maschinenteilen sowie Neuanfertigung aus Schmiedeeisen mittels Azetylenschweissung) J. J. THIESSEN. *Autogene Metallbearbeitung,* Vol. 29, June 15, 1936, pages 185-188. To avoid the danger of fractures and cracks in castings at other places when repaired by welding the pieces should be preheated. Examples are described in which new wrought Fe parts were successfully welded to cast Fe pieces where repair was impossible. Ha (7b)

Modern Process in Forging Craft with Particular Consideration of the Acetylene Welding and Cutting Technique (Neuzeitliche Arbeitsverfahren im Schmiedehandwerk unter besonderer Berücksichtigung der Azetylenschweiss- und Schneidtechnik) J. J. THIESSEN. *Autogene Metallbearbeitung,* Vol. 29, July 15, 1936, pages 215-218. A number of examples illustrate procedures for using the welding torch advantageously in the small shop in fabricating forged parts. Ha (7b)

Welded Piping and Pressure Vessels in the Marine Field. JAMES W. WILSON. *Welding Journal,* N. Y., Vol. 15, Mar. 1936, pages 6-7. See *Metals & Alloys,* Vol. 7, July 1936, page MA 355L/2. WB (7b)

Fusion Welding and Gas Cutting in the United States of America (La Soudure Autogene et l'oxycoupage aux Etats-Unis) L. DE JESSEY. *Revue de la Soudure Autogene,* Vol. 28, Apr. 1936, pages 4-9. See *Metals & Alloys,* Vol. 7, June 1936, page MA 299L/6. FR (7b)

Welding of Bridges and Structures (La soudure des Ponts et Charpentes) A. GOELZER. *Revue de la Soudure Autogene,* Vol. 28, Apr. 1936, pages 10-12. See *Metals & Alloys,* Vol. 7, July 1936, page MA 355L/9. FR (7b)

Welding Viewed from a Somewhat Different Angle. T. HOLLAND NELSON. *Steel,* Vol. 98, May 11, 1936, pages 79, 81. Abstract of paper before interchapter meeting of American Society for Metals at Pennsylvania State College, May 1-2. Discusses phenomena occurring in parent metal and weld-metal, and condition of the metals after welding and heat treating, with chief attention to alloys. Shows in shot welds of 18-8 Cr-Ni steel, that solidification of molten metal forms rings, number depending upon number of cycles of current used in making weld. Rings are formed because molten metal begins to freeze in extremely brief period between cycles. Each weld has a corona or area of metal affected by heat of weld. Weld can be so controlled that corona does not reach metal surface. Intergranular corrosion will result when corona affects 18-8 surface. In discussion, E. C. Bain contended that piping is likely to occur in welds unless metal is compacted as shown by indentations. Author stated that latter are due to pressure of electrodes and that it is possible to make shot welds without surface indentations and the welds show no piping. MS (7b)

Accurate Time Control for Resistance Welding. R. T. GILLETTE. *Welding Journal,* N. Y., Vol. 15, June 1936, pages 6-8. The necessity for close control of timing in spot welding of high C stainless steels, Al, Ni, etc. is discussed and shown to make the difference between a good weld and a reject. Details are given of seam and intermittent welds on evaporator bodies made from .025" thick 18-8 of .12% C. Rejects are less than 1/10% since application of accurate timing. WB (7b)

Welded Frame in Hydraulic Press. GEORGE M. GILLEN. *Welding Journal,* N. Y., Vol. 15, May 1936, pages 12-13. A 15,400 lb. frame is illustrated and details described briefly, weight saving (over cast design) due to welding for completed press estimated as 12,000 lbs. WB (7b)

Recent Progress in the Welding of Aluminium and Its Alloys. JACQUES DOUCHEMENT. *Aluminium & the Non-ferrous Review,* Vol. 1, May 1936, pages 391-396. See *Metals & Alloys,* Vol. 7, June 1936, page MA 299L/6. JCC (7b)

Autogenous Welding in Pipe Line Construction (Autogenschweissung im Rohrleitungsbau) F. WECKWERTH. *Autogene Metallbearbeitung,* Vol. 29, June 1, 1936, pages 161-166. Methods of joining pipes and sections to long lines by welding, handling and putting in place pipe lines of 200 m. length, and equipment used are described and illustrated. Ha (7b)

Resistance Welding Extensively Employed in Automotive Industry. J. A. WEIGER. *Iron Age,* Vol. 136, Nov. 7, 1935, pages 20-24, 102. Outlines progress made during last few years in electric resistance welding in automobile industry. Trend has been from simple to semi-automatic and fully automatic machines. Covers spot welding flash butt-welding, electrical upsetting, seam welding and projection welding. Water cooling and proper electrode and die material and design are essential. VSP (7b)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Protective Finishes on Zinc. S. W. K. MORGAN & L. A. J. LODDER. *Aluminium & Non-Ferrous Review,* Vol. 1, Mar. 1936, pages 232-237. Read before the Midland Centre of the Electrodepositors' Technical Society. JCC (8)

8a. Pickling

The Acid Cleaning of Sheet Steels. RICHARD SAXTON. *Sheet Metal Industries,* Vol. 10, Mar. 1936, pages 211-212. H_2SO_4 is recommended over HCl from a cost standpoint. A 6% H_2SO_4 bath at about 90° C. will give an output roughly 4 times that of an equal volume of HCl at atmospheric temperature. Elimination of H by heating to 200° to 250° C. or by immersion in boiling water is suggested. AWM (8a)

Pickling and Plating Brittleness of Steel. H. SUTTON. *Iron & Steel Industry,* Vol. 9, June 1936, pages 394-395. Electrolytic pickling may be effected in acid baths without embrittlement of the steel. Important conditions to be observed are, (a) low or moderate temperature of the bath, and (b) high initial current density, e.g., 100 amps./ft.^{2} the pieces being made the anode. A convenient bath contains about 30% H_2SO_4, by volume, and about 3 oz./gal. of K dichromate. The cleaned pieces are removed quickly from the bath, rinsed and transferred directly to the plating bath, if plating is desired. CEJ (8a)

8b. Cleaning including Sand Blasting

Modern Derusting Processes (Neuzeitliche Entrostungsverfahren) FR. KAPPLER. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, June 20, 1936, pages 781-784. Freeing of metal parts from rust by mechanical means, as by steel brush, tapping, sandblasting, sparking (i.e. by throwing steel grit rapidly onto the surface to be cleaned so that sparks are produced), and by chemical means, as pickling, are reviewed and the respective fields of application discussed. Ha (8b)

8c. Polishing & Grinding

Control of Abrasive Dust. Part I. FRED B. JACOBS. *Mill & Factory,* Vol. 19, July 1936, pages 45-48. Discussion of grinding methods with particular reference to the need for and existence of dust control. In practically all industries where metals are ground and polished, steps have been taken to eliminate silicosis hazards by installing large central dust collecting systems or small portable dust exhausters for non-stationary work. Wet-sand blasting is said to eliminate completely the dust hazard. Although the inhalation of silica dust is definitely dangerous, the inhalation of emery, silicon carbide or alumina does not seem to result in injury. The need for control of dust appears to be greatest in gray Fe, malleable Fe, steel and nonferrous foundries where the castings are ground dry to remove imperfections. Several grinding operations with and without dust removal equipment are illustrated. FPP (8c)

Polishing and Buffing. S. MUSCIO. *Metal Cleaning & Finishing,* Vol. 7, June 1935, pages 303-304. Describes various types of wheels used—canvas, muslin, (sewed or glued) felt, sheepskin, walrus hide, bullneck, leather, leather-covered, laminated wood and cemented paper discs. GBH (8c)

Cooling and Lubricating Liquids for Grinding (Kühl- und Schmierflüssigkeiten beim Schleifen) F. PACHTNER. *Oberflächentechnik,* Vol. 13, July 7, 1936, page 150. Water emulsions of oils are good for this purpose but the oils must not clog up the grinding discs. Emulsifying oils, as shell oil M2, which take up water in fine droplets, are the best; a mixing ratio 1 oil to 60 water is suitable. The water should not be hard (it may be softened by addition of soda) and not hot. The dilution should be 1:50 to 1:70 for grinding of Fe, steel, cast Fe, malleable Fe, brass, bronze, Cu, Ni, Ni Ag, Zn, Sn, Pb; 1:60-1:70 for Al and Al alloys, but for grinding of elektron a 4% NaF solution with oil should be used instead of water. Insulating materials, hard rubber, ebonite, should be ground dry. Ha (8c)

Using Abrasives in the Foundry. B. N. HODGES. *Abrasive Industry,* Vol. 17, May 1936, pages 16-19. General. WB (8c)

Some Notes on Finishes Produced by Mechanical Means. *Synthetic & Applied Finishes,* Vol. 6, Jan. 1936, pages 256-259. Important features of materials, method and technique used in mechanical finishing as contrasted with organic, electrodeposited or chemically applied finishes are discussed. Burnishing by tumbling is too often ignored; types of barrel, speed, inclination angles, etc. are specified. Other barrel processes are scouring or grinding, and polishing. Sand blasting is discussed as a means of scale removal for the improvement of surface finish or as a key for organic finishes. Types and sizes of sand grit are discussed and compared with more expensive steel grits. Steel grit creates less dust, minimizes safety hazard, reduces necessary screening, and cuts down handling costs. Abrasive polishing and mat-finishing are described from every angle. FPP (8c)

8d. Electroplating

Bright Nickel Solutions. PHILIP SIEVERING, JR. *Platers' Guide,* Vol. 32, May 1936, pages 36-38. Bright Ni plating is a money saver but not a cure-all. The solution has good throwing power which is an advantage on articles with deep recesses. Ni buffing is eliminated which is advantageous with articles with sharp corners. The deposit is uniform over the whole article. WHB (8d)

Tests of Insoluble Anodes of Various Compositions for Electrolytic Zinc Deposition by Standard Method. S. A. PLETNEV & A. L. SOBOLEVA. *Tzvetnuie Metallui,* June 1935, pages 48-54. (In Russian). Investigation of 8 types of Pb and Pb-alloy anodes led to the following conclusions: Best materials for insoluble anodes in electrodeposition of Zn were Pb alloyed with 1% Ag, and Pb electrolytically plated with Pb from fluosilicic acid bath. Commercial Pb and also Pb alloyed with Sb were unsuitable as insoluble anodes. Ternary alloys of Pb-Ag-Ca were also unsuitable because of their low stability. Relative potentials in the electrolysis of Zn were studied. Considerable lowering of voltage caused by destruction of anodes under the influence of current was observed when ternary alloys of Pb-Ag-Ca were used, and also slight lowering with binary Pb-Ag alloy. BND (8d)

Mesle's Chord Method for Measuring the Thickness of Metal Coatings. WILLIAM BLUM & ABNER BRENNER. *Bureau of Standards Journal of Research,* Vol. 16, Feb. 1936, pages 171-184. A study was made of methods for measuring the thickness of an electroplated metal coating at any specified part of the surface. The "chord" method depends upon just cutting through the coating on a plane surface, with a grinding wheel of known radius, or, on a curved surface, with a fine file. In either case the thickness T can be computed from C, the width of the cut, that is, the chord, and R, the radius of the wheel or curved surface, by the equation $T = \frac{C^2}{8R}$. Tests on coatings of known thickness showed that the results are accurate within about 10% for coatings at least 0.0002" (0.05 mm) thick. This accuracy compares favorably with the results obtained by measuring metallographic cross sections, a method that is more laborious and time-consuming than the chord method. WAT (8d)

Wear Resistance. Chromium Plating as an Aide to Durability and Reduction of Frictional Losses. *Automobile Engineer,* Vol. 26, Jan. 1936, page 11. The "Fescol" process is described. It consists in employing fine coatings of Cr to resist wear; Cr is electrically deposited by special methods in extremely thin but hard films which form an antifriction surface and a corrosion-resisting surface. The method is employed particularly for broaching tools, crankshafts and shackle pins. Ha (8d)

Electroplating of Metals. E. J. DOBBS. *Times [London] Trade & Engineering,* Vol. 38, Dec. 1935, page XVI. Discusses reasons for and applications of electroplating. MS (8d)

The Effect of Sodium Fluoride on the Bright Plating Range of Chromium in Chromic Acid Plating Baths. E. CURSCHMANN & H. HEINRICH. *Monthly Review American Electroplaters' Society,* Vol. 23, Feb. 1936, pages 52-54. HF, KF and NaF are substitutes for H_2SO_4 in a chromium solution. A wider plating range is claimed for them. Experiments were conducted in a glass jar 4" x 4" x 8" to determine bright plating range. Temperature 45° C., time of plating 5 min., antimonial Pb anode, polished Cu cathode 1" x 2", electrolyte 250 g./l. CrO_3, recommended concentration of NaF 8 g./l.

Table showing Bright Plating Range

NaF g./l.	Lowest c. d. at which a bright plate was obtained amps./in.^{2}	Highest c. d. at which a bright plate was obtained amps./in.^{2}
6	1.00	2.25
8	1.00	3.75
10	1.00	2.25
12	1.00	1.75

Data for Sulphate Bath

H_2SO_4 g./l.		
1.5	.50 amps./in.^{2}	1.50 amps./in.^{2}
2.7	.75 amps./in.^{2}	1.50 amps./in.^{2}

Electro-plated Gold for Special Purposes. *Synthetic & Applied Finishes,* Vol. 6, Jan. 1936, pages 249-255. Au plating is generally applied as decorative finish or for the protection of metals (Ni-silver, Ag, Ag alloys) that require only thin films for this purpose. In electrical engineering, Au plated contacts are useful because of their resistance to tarnish, good electrical conductivity, high density, by virtue of the good throwing power and high electrochemical equivalent of Au. The production of satisfactory thin deposits from a cyanide electrolyte at 50°-60° C. is described. Surface preparation of metal to be plated consists in degreasing in trichlorethylene or alkali solution followed by a sharp acid dip. A NaCN rinse prior to plating is advocated. Anodes are 24 ct. Au strip. Ni underlay is used for Au plating Fe or steel. Al alloys may be Au plated directly with a low cyanide electrolyte, or, more rapidly, with a Ni underlay and high cyanide electrolyte. For electrical purposes the use of the Ni underlay is far superior to direct Au plating. Plate is tested for weight and porosity in any case. Advantages of aurous cyanide as the electrolyte solute are discussed, and the analysis and maintenance of Au plating solutions described in detail. Au may be recovered from discarded solutions by reducing with Zn in the presence of $CuSO_4$ and dissolving the Zn in the precipitated Au sludge with HNO_3. FPP (8d)

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of METALS & ALLOYS, published monthly at East Stroudsburg, Pa., for October 1, 1936.

State of New York
County of New York } ss.

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Philip H. Hubbard, who, having been duly sworn according to law, deposes and says that he is the Business Manager of METALS & ALLOYS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

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Business Manager.

Sworn to and subscribed before me this 9th day of October, 1936,
CURVILLE C. ROBINSON.
Notary Public.

[SEAL] (My commission expires March 30, 1938.)

Certificate filed in Bronx Co., Bronx Co. Clk's No. 52, Reg. No. 37R36; N. Y. Co. Clk's No. 284, Reg. No. 6R154.

The Effect of Oxidizing Agents on Nickel Deposition. II. Chromic Acid. A. W. HOTHERSALL & R. A. F. HAMMOND. *Transactions Faraday Society,* Vol. 31, Nov. 1935, pages 1574-1582. Increasing concentrations of CrO_3 were found to cause a marked decrease in cathode efficiency and to render the deposits first, bright, then exfoliated, then burnt, and finally to result in the complete inhibition of Ni deposition. Greater effects were produced at higher than at lower pH values. Low concentrations of CrO_3 produced little, if any, diminution in gas discharge at the cathode whilst amounts in excess of .03 g./l caused a rapid increase in the rate of gas evolution. Pitting was not diminished. The effects produced can be connected indirectly, to a small degree, with depolarization of H_2. The CrO_3 acid functions in 2 ways: (1) with low concentrations, initial depolarization results in precipitation of basic Ni compounds containing Cr at the cathode and depleting Ni ion concentration and favoring H ion discharge; (2) with higher concentrations, Cr acid reacts chemically with the cathode metal to form a film; Ni deposition is completely inhibited. Different cathodic metals form different types of surface films by interaction with CrO_3. PRK (8d)

The Trend of Recent Developments in Electrodeposited Coatings. A. W. HOTHERSALL. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 115-120. In a survey of progress made in 1935 the author states that progress has been made (a) in improving adhesion, (b) in studying the mechanism of electrodeposition and the properties of deposits, (c) in the reduction of costs and (d) in control of quality by specification. Recent applications of electrodeposition are (1) resistance to wear, (2) improvement in the quality of tinplate and (3) the electrodeposition of bronze. 29 references. HBG (8d)

Electroplating of Aluminum and its Alloys with Zinc, Cadmium, Copper, Nickel, and Chromium. V. I. LAINER & S. I. ORLOVA. *Legkie Metallui,* Vol. 5, Feb. 1936, pages 22-33. In Russian. Specimens were electrolytically degreased, immersed in a basic Na_2ZnO_2 solution, and plated in the usual manner. The coatings were bright, uniform, and adhered well. HWR (8d)

A Unique Tin Plate. T. W. LIPPERT. *Iron Age,* Vol. 138, July 2, 1936, pages 20-23, 84. A new continuous electro-tinning process developed by the Pittsburgh Crucible Steel Co. is described. 5000-lb. coils are continuously and uniformly coated, porosity and other defects being avoided. Claims made for the process are: (1) continuous and uniform coating; (2) dense and lustrous Sn coating with almost complete freedom from pores; (3) elimination of pickling embrittlement and concomitant improvement in deep drawing qualities; (4) surface layer of pure Sn and therefore improved corrosion resistance; and (5) avoidance of grease lines, mottle and isolated $FeSn_2$ crystallites. VSP (8d)

Lead Plated Aluminum (La piombatura dell'alluminio) O. SCARPA. *Alluminio,* Vol. 5, Jan.-Feb. 1936, pages 1-5. Al has been adapted as a substitute for Cu in connecting storage battery terminals. The Al is first coated with Ni and then plated with Pb, the Ni serving as a bond between Al and Pb. A lead fluoborate bath was found suitable for the lead plating. AWC (8d)

The First Installation for Lead-Plating Aluminum Electrolytically (Il primo impianto di piombatura elettrolitica dell'alluminio) O. SCARPA. *Alluminio,* Vol. 5, May-June 1936, page 85. Pictures of the plant at Melzi are shown. AWC (8d)

8e. Metallic Coatings other than Electroplating

Influence of Surface Cuprous Oxide Inclusions on the Porosity of Hot-tinned Coatings on Copper. W. D. JONES. *Technical Publications, International Tin Research & Development Council,* Series A, No. 32, 8 pages. Reprinted from *Journal of the Institute of Metals,* Vol. 58, 1936. See *Metals & Alloys,* Vol. 7, July 1936, page MA 357R/9. (8e)

The Development & Control of Spangles on Galvanized Iron. Part 5. W. G. IMHOFF. *Metal Cleaning & Finishing,* Vol. 7, June 1935, pages 281-284. General discussion of the effect of pickling on hot galvanizing of sheet steel. Overpickling cuts into surface skin and produces poor spangles. Pickling may show up defects in the steel such as slag or oxide inclusions. Blisters in Zn coating are attributed to too high speed through molten Zn and insufficient time for occluded gases or for traces of acid resulting from pickling to be driven off. Opinion is given that "skinned" sheets (having a skin that can be pulled off after pickling) occur with steel having over .6 to .8% Si. GBH (8e)

The Spraying of Molten Metal. L. E. KUNKLER.* *Metallizer,* Vol. 5, Apr.-May 1936, pages 2-5. Relatively fool-proof equipment, the training of operators, and more care in the proper preparation of the surface to be coated have resulted in great improvements in metal spraying. The tensile strength of sprayed metal is low, its compressive strength high. Coatings should never be applied if there will be further fabrication such as bending, rolling, etc. Sand blasting and rough threading are the best means of surface preparation for metallizing. Wet grinding is the best way to finish metal sprayed coatings on shafts and the like. Many applications are cited. BWG (8e)

Action of Molten Zinc on Iron and on Common and Alloy Steels (Action du zinc fondu sur le fer et les aciers ordinaires et spéciaux) I. MUSATTI & A. LA FALCE. *Revue de Métallurgie,* Vol. 33, June 1936, pages 362-370. Round bars 20 mm. in diameter were selected from steels having composition suitable for determining the influence of C, Si, S, P, Cr and Ni on their resistance to attack by molten Zn. Specimens were immersed in a special apparatus (described) in a bath of Zn kept within 1.5° C. at 460°, 480°, 500° and 520° C., for 8 hours. Zn coating was removed with a 5% H_2SO_4 solution to which 2 g./l. of arsenious acid was added, after being studied under a microscope. The loss of weight was the criterion of corrodibility. C increases Zn attack but less than Si which acts quite pronouncedly. S and P have practically no influence. An 18% Cr — 8% Ni and a 12% Cr steel were corroded the same as low C steels. Corrosion ratio is controlled by the layer of Fe-Zn alloy on the surface of steel. When it contains more Fe, its melting temperature rises and diffusing attack is reduced. JDG (8e)

Caesium-oxygen Films on Tungsten. J. H. Lees. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, June 1936, pages 1131-1139. The adhesion of a film of Cs on W is considerably strengthened if the W is first coated with "activated" oxygen which can be obtained by a definite (described) heat treatment, whereby the electron emission is greatly increased. Apparatus and procedure are described in detail, results shown in curves. Ha (8e)

Metallizing in Europe. *Metallizer,* Feb.-Mar. 1936, page 11. Illustrations are given to show the spraying of statues with Zn, window sash with Zn (or Cu, bronze or Pb), and shaft couplings from large trucks on which the bearing surfaces were built up with high C steel. BWG (8e)

Spraying of Babbitt Metal. *Metallizer,* Vol. 5, Apr.-May, 1936, page 6. In lining bearings by spraying, the backing is grit-blasted before spraying, or if tinned in the usual manner, the Sn is heated with a torch to render it soft just before spraying in order to secure a fused bond. Oil must be thoroughly removed before spraying and preferably only a thin lining applied with but a slight excess to be removed by machining or scraping. Sometimes babbitt is sprayed directly on the backing with no tinning. This is followed by the usual bearing casting operation. BWG (8e)

Alloys in the Zinc Bath. G. A. Brayton. *Journal American Zinc Institute,* Vol. 17, 1936, pages 87-93. Pb and Fe alloys of Zn are always present. Although both are detrimental, the latter is very expensive to the galvanizing process, with no known method of eliminating it. No other metal or alloy has been found which materially reduces the dross production. Addition of Sn alone works best in the Zn bath and produces the best results in adherence, uniformity, and appearance of the coating. It has the added advantage of being easily controlled. Al is beneficial in hand-dip pots only. Very little is known about the action of other metals; some experiments with additions have had disastrous results. Cd, perhaps, may deserve a place in the Zn bath, especially when obtainable as byproduct in Zn at a price comparable to the process. Experiments are underway along this line with amounts from less than 0.5% to 83% Cd. BHS (8e)

Applications of Electric Heating in Galvanizing (Les Applications du Chauffage Electrique en Galvanisation). P. Etienne. *Science et Industrie (Electricité),* Vol. 20, Mar. 1936, pages 122-125. Zn coating is obtained electrolytically or by the hot dipping process. The latter is dealt with in the article. Author discusses use of fuel furnaces and electric heating, and describes types of furnaces available. Advantages of electric heating are: accurate control of temperature, savings by reducing dross formation, long life of pots, suppression of pickling after heat treatment and improvement of quality of product. FR (8e)

■ 8f. Non-Metallic Coatings ■

Surface Preparation, Thickness Control Are Factors in Good Enameling Practice. *Steel,* Vol. 98, May 4, 1936, pages 54, 56, 59. Thorough cleaning of metal surface just prior to application of enamel is necessary to eliminate fish-scaling, copperheading, and blistering. Fe salts on the pickled surface not removed by H_2O rinse may be dissolved by dipping in a solution containing 2 oz. Na_2CO_3 and 2 oz. NaCN per gal. H_2O. By giving metal Ni-dip after pickling, adherence of enamel is improved and copperheading and fish-scaling are decreased markedly. For white ground coats, a solution of 8 oz. $NiSO_4$-$7H_2O$/gal. is used; for Co ground coats, 4-5 oz./gal. Best deposit is obtained when pH is 5.6-6.2. About ¼ oz./gal. H_3BO_3, with or without $(NH_4)_2CO_3$ or NH_4OH, is usual buffer compound used as stabilizer. Temperatures used vary from 110° to 190° F. If film of $Fe(OH)_3$ forms on steel during Ni deposition, it can be removed by rinsing in a 0.1% solution of H_2SO_4. This removes film but not the Ni. Loss by chipping can be reduced by use of relatively thin enamel coatings. In one plant it was found that with thicknesses above 0.021″ losses were nearly 7 times greater than those with thicknesses below 0.018″. MS (8f)

Automatic Lacquering, Enameling and Japanning. Charles W. Hardy. *Metal Industry,* New York, Vol. 34, July 1936, pages 247-249. Automatic dipping units give a better finish at lower cost. CBJ (8f)

Surface Coloring of Metals Extended to Stainless Steel. *Steel,* Vol. 98, May 4, 1936, page 59. Describes process developed by Oscar B. Bach consisting essentially of treatment of the oxide film on stainless steel so that it will reflect the desired color. Steel surface is covered with a compound and heated to 350°-400° F. Chief factors are proper composition of compound [not stated] and length of time it is permitted to react with oxide film. It is claimed that by accurate control of process any desired color can be produced. Process may be used only with stainless steel, as it is based on reactions obtained only with steel containing Cr and Ni. Resulting surface is said to be resistant to abrasion. Where unusual fabricating operations are required, or where heat is applied, desired color may be developed after fabrication has been completed. It is claimed also that the treatment increases resistance of stainless steel to corrosion by HF, HNO_3, and other acids. There is a possibility that similar color finishes may be developed on mild steel by addition of small amounts of alloying elements and modification of the process. Definite information on the real merits of the process is lacking. MS (8f)

Paint and Lacquer Problems with Aircraft Materials (Lack-und Firnisprobleme bei Luftfahrzeugen) E. W. J. Mardles. *Farbe und Lack,* Issue 26, June 26, 1935, page 305. The rigorous conditions to which aircraft member surfaces are exposed and the requirements that protective finishes must meet are discussed. FPP (8f)

Anodic Oxidation of Aluminum and Its Industrial Application. The Development of the Aluminum Industry in Japan (Die anodische Oxydation von Aluminium und ihre industrielle Anwendung. Die Entwicklung der Aluminium-Industrie in Japan) *Aluminium,* Vol. 18, July 1936, pages 313-314. Statistics on consumption and production, present status of industry in Japan. Ha (8f)

YOU CAN REPEAT ALMOST EVERY EXPERIENCE IN LIFE —EXCEPT

life-itself

Today is life. Tomorrow is a hope. Yesterday is a dream. Nothing is so dead as a day that has passed. Only the trailing clouds of memory remain.

One *today* upon another *today* — how quickly a decade is built! Youth approaches manhood in high heart, embraces maturity as the period of his conquest, then "remembers with a sigh the days that are no more."

So life goes — like that. NOW is the only opportunity. NOW is the moment of success. NOW men decide — NOW men win or fail.

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9. TESTING

Design, Construction and Test of a Pair of Built Up Plate Girders Fabricated by Means of Fusion Welding. SAMUEL COUSIN. *Journal South African Institution of Engineers,* Vol. 34, July 1936, pages 317-324. An outline with special attention given to an overload test of the built up plate girders. WHB (9)

■ 9a. Inspection & Defects, including X-Ray Inspection ■

C. S. BARRETT, SECTION EDITOR

Defects in Forgings and Castings. *Journal of Commerce, Shipbuilding & Engineering Edition,* July 2, 1936, page 7. Description of a magnetic detector for revealing flaws, which consists of a shallow circular brass dish with a thin flat back and a transparent cover. The dish is rendered oil tight and filled with a mixture of magnetic dust and oil, after which it is laid horizontally on the magnetized article; when settling to the bottom the magnetic particles migrate towards the defects if any. JWD (9a)

Non-destructive Testing of Ingot Iron Welds by Means of Gamma Rays (Zerströrmungsfreie Prüfung von Flusseisen-Schweissnähten mittels Gammastrahlung) M. WIDEMANN. *Autogene Metallbearbeitung,* Vol. 29, July 1, 1936, pages 196-199. Experiments are described which prove that welded seams of ingot Fe up to 40 mm. thickness can be reliably tested with γ-rays for defects in binding, fine cracks, blisters. The width of cracks must be at least 0.2 mm. Blisters must have a diam. of at least 2 mm. Ha (9a)

Non-destructive Testing of Heavy-metal Pieces with Ultra-short Wave X-rays (Zerstörungsfreie Prüfung schwermetallischer Werkstücke mit ultrakurzwelliger Röntgenstrahlung) M. WIDEMANN. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, June 13, 1936, pages 741-745. The advantages of X-ray testing with apparatus up to 400,000 v. are explained. Welds, thick and large pieces can be radiographed and defects recorded in short time. Examples are shown. Ha (9a)

Invisible Rays in Modern Engineering. GILBERT E. DOAN. *Steel,* Vol. 98, May 11, 1936, page 68. Paper before interchapter meeting of American Society for Metals at Pennsylvania State College, May 1936. Deals with known electromagnetic rays and their use, especially gamma rays and X-rays in inspection and study of metals. MS (9a)

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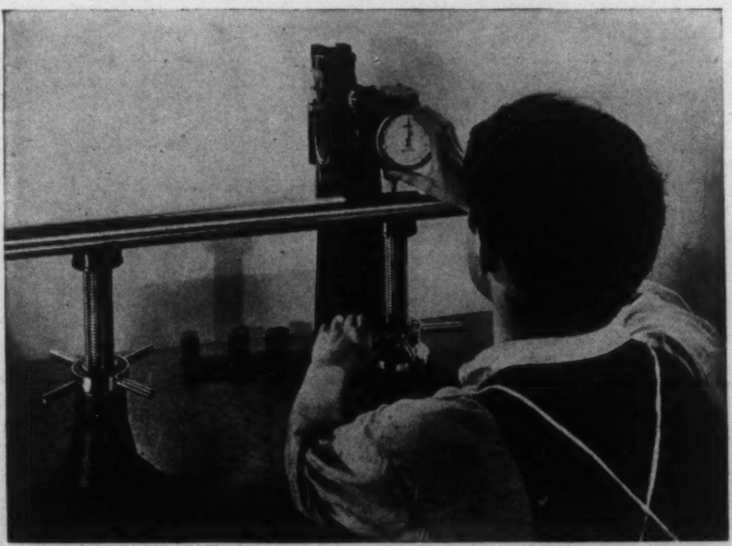

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■ 9b. Physical & Mechanical Testing ■

W. A. TUCKER, SECTION EDITOR

The Variations of Young's Modulus with Magnetization and Temperature in Nickel. SIDNEY SIEGEL & S. L. QUIMBY. *Physical Review,* Vol. 49, May 1936, pages 663-670. The relation between Young's modulus, magnetization, and temperature in annealed polycrystalline Ni, 99.7% pure, is determined for values of J, intensity of magnetization, between zero and saturation, and for values of temperature between 23.5° C. and 400° C. The per cent increase in Young's modulus is proportional to J^2 between zero and about 0.4 saturation, at all temperatures below 311° C. The total increase in the modulus from the demagnetized to the saturated state is 6.7% at 23°, reaches a maximum of 18.7% at 185°, and decreases to zero at the Curie point. The method employed for the measurement of Young's modulus yields at the same time a measure of the coefficient of internal friction of the material. The internal friction decreases with increasing magnetization at all temperatures below the Curie point. In the demagnetized material it reaches a maximum value at the same temperature as does the change in elastic modulus. Its value at magnetic saturation is the same order of magnitude as that of a nonferromagnetic substance. WAT (9b)

Determination of Bearing Properties of Metals. N. N. SERAFIMOV. *Metallurg,* Vol. 11, June 1936, pages 102-108. In Russian. Instructions for use, preparation of samples and interpretation of results obtained with Mohr & Federhoff friction testing machine. (9b)

Some Special Test-pieces for the Iron Foundry (De quelques Eprouvettes speciales en Fonderie de Fer.) L. J. GOUTTIER. *Revue de Fonderie Moderne,* Vol. 30, Mar. 10, 1936, pages 75-79; *Foundry Trade Journal,* Vol. 54, Apr. 16, 1936, pages 299-300. By special test-pieces it is intended to signify not those which are generally included in specifications, such as tensile, transverse, hardness, and the like, but those which are helpful in the conduct of one's foundry. A "touch" test piece, porosity test-piece, test piece for internal stresses and test pieces for molding materials are described. The "Touch" and porosity test pieces are of a particular interest. The "touch" method devised by J. Sonnenfeld consists of casting a truncated test-piece in a metallic mold. This method allows an approximate estimate of the sulphur content. The internal wall of this test-piece is carefully polished. Up to 0.07 per cent of sulphur, the surface of the test-piece is quite smooth; when the percentage increases, it becomes rougher and forms thousands of needle points; at 0.13 per cent it is practically impossible to allow the finger tip to touch it; moreover, a careful examination discloses that there are very minute cracks. The porosity test-piece consists of two thin hollow cylinders, arranged in parallel and joined at their centre by a large mass of metal, situated directly under the runner. After cooling, the runner is broken and the test-piece is fractured along the parting line between the two cylinders. A sound fracture, at this place, where the most favorable conditions exist for drawing, indicates that a non-oxidized iron, liable to give sound castings, has been used. The paper is well illustrated. AIK + Ha (9b)

A Deep-drawing Test for Aluminum. A. G. C. GWYER & P. C. VARLEY. *Sheet Metal Industries,* Vol. 10, Apr. 1936, pages 309-311, 324. Paper before the Institute of Metals. See *Metals & Alloys,* Vol. 7, June 1936, page MA 308L/7. AWM (9b)

■ 9c. Fatigue Testing ■

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

Endurance of Case Hardened Gears. O. W. McMULLAN. *Transactions American Society for Metals,* Vol. 24, June 1936, pages 262-280. Paper presented and discussed at Chicago Convention, 1935. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 502L/7. WLC (9c)

Endurance Strength Diagrams of Steels at Different Average Tensile Stresses with Consideration of the Shape of the Test Specimen (Dauerfestigkeitsschaubilder von Stählen bei verschiedenen Zugmittelspannungen unter Berücksichtigung der Prüfstabform) A. POMP & M. HEMPEL. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Düsseldorf, Vol. 18, No. 1, 1936, pages 1-14. Tests are described which were made for the purpose of determining the influence of a static tension on which is superimposed an oscillating stress; the diagrams were taken on specimens of ground and polished round bars of Cr-Ni and C steels and of these steels as rolled. The tests are described in detail and were made on a Schenck testing machine. The increase of the limiting stress is closely connected with the elastic limit of the material and clearly shown in the curves. A bar machined on all sides causes an increase (7%) of the alternating strength of 1 to 3 kg./mm.^{2} over the bars as rolled. The ratio, alternating endurance strength to tensile strength, showed for both flat and round bars a decrease with increasing tensile strength. 15 references. Ha (9c)

The Influence of Temperature on the Severity of Corrosion Fatigue. A. J. Gould. *Engineering,* Vol. 14, May 8, 1936, pages 495-496. Describes a constant-temperature room and a Haigh-Robertson fatigue testing machine for measuring corrosion fatigue. Tests were conducted on mild steel wire. Composition of steel was: C 0.17%; Si 0.02%; Mn 0.55%; S 0.035%; and P 0.038%. Test pieces were of 150 diam. length. Artificial sea water was used as corrosive medium. Tests were carried out at temperatures from 15° to 45° C. Endurance of the order of 10 million reversals is approximately halved. Includes graphs showing influence of temperature. VSP (9c)

Fractures without Deformation in Boiler Parts (Verformungslose Brüche an Kesselteilen) W. Ruttmann. *Technische Mitteilungen Krupp,* Vol. 4, Mar. 1936, pages 23-29. See *Metals & Alloys,* Vol. 7, July 1936, page MA 361L/4. Ha (9c)

Endurance and Design of Cast Crankshafts. Thum & Bandow. *Metal Treatment,* Vol. 2, Spring 1936, pages 42-44. Abridged translation from *Zeitschrift Verein deutscher Ingenieure.* See "The Cast Crankshaft," *Metals & Alloys,* Vol. 7, July 1936, page MA 361L/6. JOC (9c)

9d. Magnetic Testing

L. REID, SECTION EDITOR

The Deflection of Cosmic-Ray Charged Particles in Passing through Magnetized Iron. W. E. Danforth & W. F. G. Swann. *Physical Review,* Vol. 49, Apr. 1936, pages 582-591. Experiments are described in which the deflections suffered by cosmic-ray electrons in passing through the saturated Fe core of an electromagnet are detected by means of Geiger counters. The observed effects are compared with the results of calculations in which the energy distribution is used as found by Anderson and Neddermeyer with the cloud chamber. In this way it was possible to set limits to the effective magnetic vector within the Fe. Experiments indicate a value lying between the induction B and B/2. Calculation points to the limits 3B/4 and B/4. A theoretical discussion is included in which it is pointed out that all electrons of the same energy will not necessarily experience the same deflection but will show a statistical distribution of deflections with an arithmetic average corresponding to the induction B. The present type of experiment, however, does not give a true arithmetic average and would be expected to indicate, for the effective deflecting vector, a quantity less than B to an extent dependent upon the particular arrangement. WAT (9d)

Variation in the Magnetization of Ni, Permalloy and Ni Single Crystals at High Field Strengths (Über die Änderung der Magnetisierung von Nickel und Permalloy sowie von Nickel—Einkristallen bei Hohen Feldern) Gerd Gerloff. *Zeitschrift für Physik,* Vol. 99, Apr. 2, 1936, pages 585-594. At room temperature in a field of 4000 gausses, the susceptibility of Ni and permalloy reach a limiting value which only varies about 6% when the field is increased to 5500 gausses. This limiting value for Ni is 1.5×10^{-4} (±4%) and for permalloy it is 2.2×10^{-4} (±4%). FHC (9d)

Electromagnetic Testing of Steel Ropes (Elektromagnetische Prüfung von Stahldrahtseilen) H. Mackh. *Archiv für Technisches Messen,* Vol. 5, May 1936, pages T64-65. Measuring methods with a.c. for the inspection of steel ropes in service are described and instruments explained. Ha (9d)

A Theoretical Discussion of the Deviation of High Energy Charged Particles in Passing through Magnetized Iron. W. F. G. Swann. *Physical Review,* Vol. 49, Apr. 1936, pages 574-582. A critical discussion of the situation pertaining to the magnetic field in a piece of magnetized Fe, particularly in relation to the deflecting force which it produces on high speed charged particles passing through it, is made. On the Lorentzian theory the magnetic induction, B, is the average value of the true magnetic field H, averaged throughout the magnetic material. In this average, regions inside the magnetic entities responsible for the polarization make contributions which determine the whole difference between B and the ordinary macroscopically defined field, h, equal to $B - 4\pi I$. A study is made of the special case where the entities are rotating electrically charged spheres. If the entities are very small in volume the chance of a point electron missing all of them in its passage through a reasonably small length of the magnetized material is considerable. It appears that for such electrons as miss the entities the effective deflecting force is determined on the average by $h + 2\pi I$. The true average for all electrons passing through the material is determined by $B = h + 4\pi I$; but, that average is contributed to in appreciable amount by very few electrons which experience deflections much in excess of those determined by B. WAT (9d)

9e. Spectrography

L. W. STROCK, SECTION EDITOR

A Photometric Method Suitable for Spectrum Analysis. D. H. Follett. *Journal of Scientific Instruments,* Vol. 13, July 1936, pages 221-228. A method of determining the relative intensities of two spectral lines of nearly the same wave-length is described. It is based on the use of the "stepped wedge" made by depositing Pt on fused silica. Microphotometric readings are taken on the density of 2 consecutive steps on one line of a pair, and a similar reading on a step of intermediate density on the other. An expression is derived from which the relative intensities of the lines can then be calculated. Tests show that the accuracy of the method is such that the probable error of a single determination is about 1½%. Preliminary results of an application of the method to the quantitative analysis of Pb and Sn are given. RAW (9e)

The Use of the Spectrograph in Industry. H. W. Lohse. *Sands, Clays & Minerals,* Vol. 2, Apr. 1936, pages 133-141. Principles of spectrometry, methods of application for industrial routine purposes, and apparatus are described. Tables of flame spectra and analyses of minerals and solutions are added. 15 references. Ha (9e)

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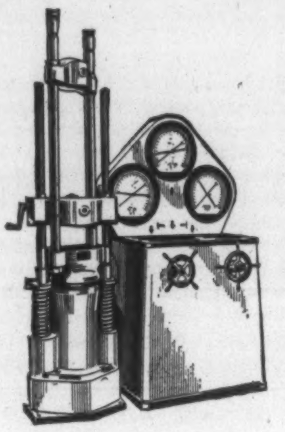

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10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Mechanism of the Decomposition of Al-Mg Solid Solutions (Mécanisme de la Décomposition des Solutions Solides Aluminium—Magnésium) PAUL LACOMBE & GEORGES CHAUDRON. *Comptes Rendus,* Vol. 202, May 25, 1936, pages 1790-1792. To show the change in solution potential of an Al alloy containing 9% Mg when annealed at different temperatures, a comparison was made of an electrode of the alloy against the standard calomel electrode in an aerated solution of 3% NaCl.

Heat Treatment	Quenched	Reheated 300° C.	Reheated 200° C.
Potential in Volts	— 0.800	— 0.820	— 1.07

The constituent precipitated at a lower temperature is unstable and richer in Mg than the intermetallic compound Al_3Mg_2 which is the β phase. This is analogous to the beginning of precipitation of Cr carbide in Fe-Ni-Cr alloys which leaves the surrounding areas Cr poor. FHC (10)

Orientation of Oxide Films on Iron. R. F. MEHL & E. L. MCCANDLESS. *Nature,* Vol. 137, Apr. 25, 1936, page 702. Fe_3O_4 formed by decomposing films of FeO on single crystals of Fe was found to be identical in orientation with the parent FeO phase. Parallel orientations were likewise found between a natural crystal of Fe_3O_4 and the FeO phase grown on it by reduction. The reason for different rates of oxidation of different grains (even when only cubic oxide is formed) must be sought in this relationship, and in the lattice conditions it produces at the interface, since diffusion in cubic materials is probably isotropic. The discontinuity in rate of oxidation at the A_3 point is considered to be a result of different orientation relationships of oxide on α and γ iron. CSB (10)

Advantages of Bakelite Mounting Small Specimens. F. L. ROBBINS. *Metal Progress,* Vol. 29, June 1936, page 74. This type of mounting is superior to low-melting alloys in making possible a flat surface over the entire cross-section of the specimen and being resistant to most of the etching reagents. WLC (10)

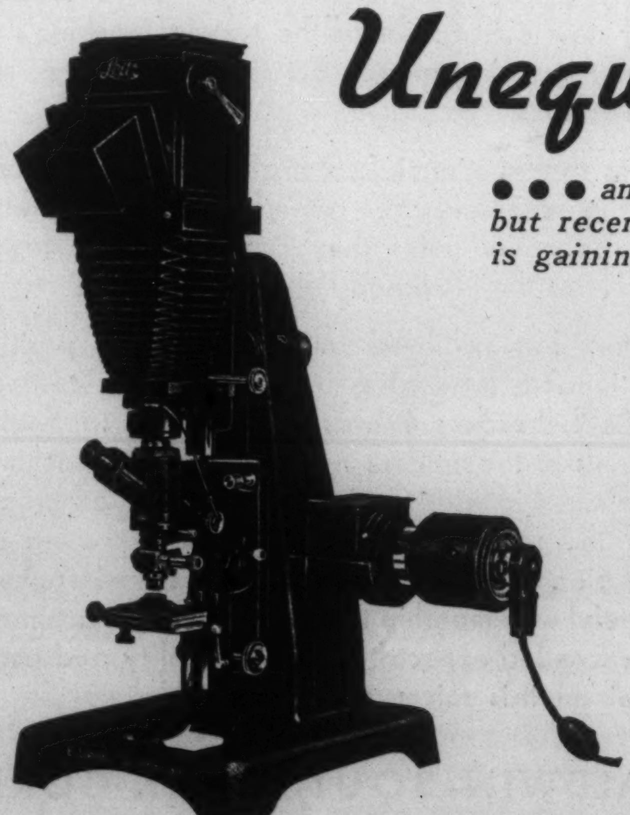
New Technique for Obtaining X-ray Powder Patterns. R. A. STEPHEN & R. J. BARNES. *Nature,* Vol. 137, Mar. 28, 1936, pages 532-533. Explains points of difference between authors' method of reflection at small angles from a flat specimen, (*Nature,* Vol. 136, 1935, page 793) and Brentano's method (*Nature,* Vol. 136, 1935, page 988). CSB (10)

Fine Structure of the L_{23} Absorption Edge of Magnesium Metal. H. W. B. SKINNER & J. E. JOHNSON. *Nature,* Vol. 137, May 16, 1936, page 826. Measurements are given of the fine structure of absorption edges in the region of 100-300 A.U. X-rays, leading to data on energy levels of electrons in metals.

X-Ray Diffraction Study of Liquid Sodium. L. P. TARASOV & B. E. WARREN. *Journal of Chemical Physics,* Vol. 4, Apr. 1936, pages 236-238. The X-ray scattering curve for liquid Na was obtained photographically with Mo Kα radiation, monochromatized by reflection from rocksalt. The significance of the curve as giving a picture of a simple monatomic liquid is discussed. FPP (10)

Physical Changes in Steel During Hardening, Annealing, and Heat Treating (Beiträge zur Frage nach den Zustandsänderungen des Stahles beim Härten, Anlassen und Glühen) A. VON VEGESACK. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 227, May 12, 1936, pages 145-178. **(Bidrag till fragan om stalets tillstandsändringar vid härdning, anlopning och glödgning)** *Jernkontorets Annaler,* Vol. 120, Feb. 1936, pages 49-98. The steels used analyzed approximately 1.24%, 1.04% and 0.70% C, and had been hardened from temperatures of 800° to 1100° C. Annealing was carried out in 25° increments from 50° to 700° C. for 5 hr. periods. Heat treatment for 150 hrs. at 700° C. was carried out on the samples after the annealing series had been completed. The following results were noted. (1) Annealing from 75° to 125° C. causes a slight increment in the hardness. (2) The linear and cubical expansion show a maximum at 200°-250° C. which increases with the C content and the hardening temperature. The hardness shows either a maximum or minimum at the same point. (3) At 350° C. the linear and cubical expansions decrease. (4) At 600° C. they begin to increase again and more rapidly for the higher C contents and hardening temperatures. Where the increase is large, the hardness decreases more rapidly. (5) This increase is accompanied by a separation of C, which appears very markedly for the large changes as the stable system Fe-C, but only in microscopic amounts for small changes in the linear and cubical expansion. (6) The quantity of C separated is proportional to the time at which the hardened steels have been annealed between 25° and 400° C. prior to prolonged heating at 700° C. (7) C separation did not appear to take place except in steels which had been hardened. (8) The lamellar martensite is visible up to 600° C. It remains light in color and throws out little or no cementite at higher annealing temperatures. The austenitic base gradually decomposes at 525° C. to pearlitic granular structure. (9) On hardening hyper eutectoid steel at various temperatures from the homogeneous γ field, the specific volume increases with the hardening temperature. (10) The author concludes that martensite has no greater solvent power for C than other α iron, and that the chief condition for hardening is the separation of a highly dispersed C during the formation of martensite. HCD + WB (10)

Lower Sulphides of Cobalt. The Co-CoS Phase Diagram (Uber die Neideren Sulfide des Kobalts. Das Zustandsdiagramm des Systems Co-CoS) OTTO HULSMANN & FRIEDRICH WEIBKE. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 227, May 12, 1936, pages 113-123. WB (10)



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Principles of Metallography. Robert S. Williams & Victor O. Homerberg. 3rd Edition. McGraw-Hill Book Company, New York, 1935. Cloth, 5½ x 8¼ inches, 313 pages. Price $3.50.

The purpose of this book is the presentation of the fundamentals of physical metallurgy and of laboratory metallography to the general reader. It is directed in particular to the student of engineering in divisions other than metallurgy. The third edition differs materially from its predecessors both in content and arrangement, a large part of the text having been rewritten and expanded and the 6 chapters having been rearranged into a more logical order.

The subject of phase diagrams is now treated in 2 consecutive chapters in an easily understood manner. Each type of alloy system is introduced by its characteristic thermal behavior, from which the constitutional diagram is developed. Real systems are used for illustrative material in most cases and the typical microstructures found are explained upon the basis of the diagrams involved. Only the cases of complete immiscibility, the eutectic, the solid solution, the congruently melting compound, the peritectic and the eutectoid are discussed, leaving the reader in danger of assuming that no other general types occur in alloy systems. There is a brief and none too clear presentation of the application of the phase rule to alloy diagrams. For the most part the material has been brought up to date, but a few of the diagrams remain in an obsolete form.

Non-ferrous metallography is covered in a single chapter of 45 pages. Even though the discussion is limited to the light alloys and those of Cu base, the emphasis being placed heavily upon the latter, it is necessarily highly condensed and consists chiefly in a listing of a few of the more important commercial alloys together with their mechanical properties, uses and typical microstructures. In addition short explanations of such fundamental properties of metals as work-hardening, slip, twinning and age-hardening are introduced. It is unfortunate that the phase diagrams of certain of the more common Cu base alloys are all that are given in this chapter, because there are others, notably in the field of light alloys that seem of equally great or greater importance. The new material added includes paragraphs on Mg and Cu-Be alloys, a section on corrosion and one on age-hardening.

The fourth and fifth chapters dealing with Fe and steel, as formerly, comprise the major portion of the volume. Here, in a conventional manner, is presented the Fe-C diagram together with a clear, though not fully modernized, exposition of the influence of composition, working and heat treatment upon the mechanical properties and microstructure of steels. The section treating the alloy steels has been completely rewritten and much new material has been added. Among the special alloys now discussed are those of Fe with Ni, Cr-V, Cr-Ni, Mo, Cr-Mo, Ni-Mo, W, Al, Cu and the high speed and stainless steels. Proportionally long sections are now devoted to cast irons, case hardening, the effect of impurities upon steel, and the corrosion problem. The second of the 2 chapters on Fe and steel is devoted to the technique of macroscopic examination. Many excellent photographs of typical macroscopic defects are included.

Laboratory methods of thermal analysis, microscopy, photomicroscopy, magnetic testing and X-ray analysis are treated in the concluding chapter. The section dealing with thermal analysis is little more than a running account of the usual type of procedure with too little attention devoted to the fundamentals of thermometry. The treatment of microscopy is generally superior to that found in most tests of this class. It is somewhat overburdened with pictures of the various makes of equipment, but includes a very helpful, though not exhaustive, explanation of the optics of the metallographic microscope. There is in addition a thoroughly satisfactory description of the preparation of metallographic specimens in which the newer techniques of mounting in plastics are mentioned. Only a few pages of general descriptive matter, of little help for laboratory directions, are devoted to the subjects of magnetic testing and X-ray methods. In an appendix there is given an outline of a brief laboratory course in Metallography, a greatly abridged list of commercial alloys and an extensive table of etching reagents.

In the course of revision much obsolete material has been eliminated, but the careful reader may still take exception to some of he statements remaining in the text. Only a few serious errors were found. Among these may be mentioned cooling curves with reversed curvature and supposedly "typical age-hardening curves" of a most abnormal sort. On the whole the book is excellently adapted to its purpose and its acceptance by the interested public is guaranteed by the success of the earlier editions. The printing is large enough to be comfortably read and the reproductions are excellent.

F. N. Rhines (10) -B-

Macrographic Control (Control Macrografico) *Metalurgia y Construccion Mecanica*, Vol. 2, May 1936, page 1.

FRM (10)

Scale on Galvanizing Sheets (Die Zunderschicht auf Blechen zum Verzinken) H. Bablik. *Oberflächentechnik*, Vol. 13, June 2, 1936, pages 125-127. Origin and nature of scale are explained and the importance of correct pickling for hot galvanizing is pointed out, especially the difficulty of pickling sheets which are double for rolling, and of annealing of cold rolled sheets. In the latter process, a reduction of the scaled surface takes place by reaction of the C of the sheet with the O of the scale with the formation of CO; this scale structure is different from the scale formed in the rolling process which is pure oxidation. The amount of roll scale formed depends on the kind of Fe, composition of the oxidizing medium, oxidation temperature and duration and can be calculated from $W = K\sqrt{t}$, where W is the scale formed, K is a constant and t the duration of reaction. Curves are given. The composition of the scale has been determined by experiment:

Material	End temp. of rolling	Total scale	% Fe_2O_3	% Fe_3O_4	% FeO
Ingot iron	780° C.	0.013 mm.		60	40
Swedish Lanes iron	980° C.	0.035 mm.		20	80
Mild steel	980° C.	0.045 mm.	11	22	67
Staffs. wrought iron	1245° C.	0.036 mm.		11	89

As the FeO layer forms the principal part of the scale the pickling process has to attack this layer particularly.

Ha (10)

The Beilby Layer. G. I. Finch & A. G. Quarrell. *Nature*, Vol. 137, Mar. 28, 1936, pages 516-519. Reviews history of attempts to determine nature of polished layers on metals, from 1665 to the Faraday Society Symposium on "The Structure of Metallic Coatings, Films, and Surfaces" of 1935. 27 references.

CSB (10)

Orientation in Peritectic Structures. Alden B. Greninger. *Nature*, Vol. 137, Apr. 18, 1936, page 657. Preliminary results from an X-ray study of the peritectic reaction $\alpha + \text{liquid} \rightarrow \beta$ in the Cu-Zn system prove that the orientations of the β crystals are definitely related to the α crystal orientations, the relation being that found for the decomposition of Fe-Ni by Nishiyama and Wasserman.

Crystal Plasticity (Kristallplastizität) E. Schmid & W. Boas. Julius Springer Verlag, Berlin, 1935. Paper, 5½ x 8½ inches, 373 pages. Price 32 RM.

This is the seventeeth monograph of the well-known series on the structure and properties of matter founded by Prof. M. Born and J. Franck.

The authors have summarized in very complete fashion the great amount of research done in recent years on the plasticity of crystals; by far the larger part of the book relates to metal crystals, and the book is therefore of interest primarily to metallurgists.

The material is treated under the following headings: crystallographic fundamentals; crystal elasticity; preparation of crystals; orientation determinations; geometry of the crystal deformation process; plasticity and strength of metal crystals—elements of translation and twinning, dynamics of translation, dynamics of twin formation, fracture along crystal faces, after-effects and reversed loading, change in physical and chemical properties on cold working, recrystallization; plasticity and strength of ionic crystals; theories of crystal plasticity and strength; explanation of the properties of polycrystalline technical metals upon the basis of the behavior of single crystals.

Although there had been work on the crystallographic mechanism of deformation of metal crystals as early as Osmond (and earlier), most of our present knowledge originated in the work done in the Kaiser-Wilhelm-Institut für Metallforschung by Schmid, Polanyi, Mark and others. This book includes all of this work and includes also work done elsewhere. Apart from Elam's book, which is much less complete, this is the only complete summary available of this field—a field which has caused the metallurgist many misgivings.

The study of the mechanical properties of metals is a field of rapidly increasing importance to the metallurgist, and the modern metallurgist may well pay close and studious attention to this excellent book. For those who are interested as intelligent students in the science of metals (may their tribe increase) this book will be a delight and a stimulation. While many metallurgists look askance at work on single crystals, and the difficult X-ray methods and geometric methods which it requires, a serious study of the properties of single crystals is of immense basic importance to the understanding of the behavior of industrial materials. The subject is a very wide one with infinite ramifications: the surprising thing about it is not the slowness with which the results of research have been applied to industrial problems, but the rapidity with which knowledge in the field has advanced. It has often been said that the material engineer has nothing to learn from the behavior of single crystals, that his needs are amply met by his knowledge of the behavior of materials in the condition used. There is, of course, a good deal of justification for this point of view though it is fearfully short-sighted. It seems necessary continually to repeat the principle, long since learned by physicists and chemists, that fundamental research has and will have in increasing measure a real practical outcome, and that such research has a practical result not seen in the cursory glance, a result consisting in an increasing knowledge of behavior leading to simpler and more correct modes of thought. The papers by Jeffries a decade ago on recrystallization and grain growth and on slip resistance—papers on the pure science of metals—have resulted in greatly improved efficiency in the thinking and thus the usefulness of the practicing metallurgists; is it extreme to say that they have been worth millions of dollars to the metallurgical industries? Books such as the present one serve such a purpose, and when admirably written, as this one is, are heartily to be welcomed.

The authors have presented not only a summary of the information available in the field, but have produced a working text, in which the geometric and crystallographic methods of analysis and the treatment of elastic theory are given in full detail, so that the book may be used as a handbook by anyone working in this field. It is, of course, not to be used by the beginner, but can readily be understood by those with training in crystallography, mineralogy, or modern physical metallurgy. Tables are given summarizing much of the data. photographs of deformed crystals are used to illustrate the text; X-ray photograms are produced to give graphic representation of preferred orientation.

The book is well printed and the diagrams and illustrations are attractively reproduced. If you would follow the course of one highly important branch of modern physical metallurgy you will have this book.

Robert F. Mehl (10) -B-

A bibliography of 703 references is appended.

CSB (10)

Influence of Supercooled Austenite on Thermal Treatment of Steel. N. P. Grechko & M. I. Korukov. *Metallurg*, Vol. 11, Apr. 1936, pages 3-16. In Russian. Results obtained with interrupted, isothermal, and usual quenching are compared for steels having the composition: 0.66% C; 0.38 C, 1.24 Cr, 3.42 Ni; 0.38 C, 0.84 Cr, 2.23 Cu; 0.34 C, 0.66 Cr, 2.92 Ni, 0.55 Mo, 0.15 V; 0.48 C, 1.85 Cr, 3.29 Ni, 0.31 V; 0.63 C, 2.15 Cr, 2.04 Ni, 0.43 Mo and 0.39 C, 1.90 Si, 0.83 Cr, 3.42 Ni, 0.76 Mo, 0.14 V. Physical properties studied showed that interrupted quenching gives the same results as the normal quenching, but reduces internal strains. Isothermal quenching produces in all steels tested a greater elongation and impact strength than straight and interrupted quenching. The ratio proportional limit-tensile strength is greater after straight and interrupted quenching than after isothermal in all steels tested with the exception of Cr-Ni-Mo-V steel. Cooling speed after 400°-500° C. soaking has a pronounced influence on the final hardness and mechanical properties of the metal, so that with interrupted quenching a cooling speed is obtained which is sufficiently slow for assuring stability of austenite during the second stage of transformation, 540°-300° C. 103 references.

(10)

Cohesion of Alkali Metals. Paul Gombás. *Nature*, Vol. 137, June 6, 1936, page 950. Theoretical calculations of heat of evaporation of K, Rb, and Cs have been made which agree with experimental values within 25% to 30%; the details will appear elsewhere.

CSB (10)

Temperature of Formation of the Metastable γ' Phase in Cu-Al Alloys and Its Dependence on Al Concentration (Temperatur der Bildung der Metastabilen γ' Phase von Cu-Al-Legierungen und ihre Abhängigkeit von der Al-Konzentration) V. Gawranek, E. Kaminsky & G. Kurdjumow. *Metallwirtschaft*, Vol. 15, Apr. 17, 1936, pages 370-371. Alloys of Cu with 12.9 to 13.5 weight % Al, with 0.1% increments, were quenched in an oil bath at 250° to 300° C., retaining the β for a short time, then the thermal curves measured when cooled in air from this temperature, and the resulting structures examined by X-rays. The thermal arrests fell on a smooth curve from 250° at 12.9% Al to 160° at 13.4% which is continuous with the earlier results for the β_1-β_1' transformation. The final structure of the 12.9-13.1% Al samples was $\beta' + \gamma'$; 13.2-13.4% showed γ' only. Experiments also showed the β_1-γ' transformation to be irreversible. These results are correlated with previously published information on these transformations.

GD (10)

11. PROPERTIES OF METALS AND ALLOYS

The Vapour Pressure of Red Phosphorus. H. W. MELVILLE & S. C. GRAY. *Transactions Faraday Society,* Vol. 32, July 1936, pages 1026-1030. The vapor pressure of red P was determined by evaporation in a vacuum. Application of the Herz-Knudsen effusion equation to the results gives values for the vapor pressure about 10^7 times lower than the normal static method. The new values are given by the equation

$$\log_{10} p \text{ (mm.)} = -\frac{4110}{T} + 1.1.$$

The reason for the discrepancy is due to P_2 molecules condensing on and evaporating from red P. PRK (11)

Studies on Cast Red Brass for the Establishment of a Basic Classification of Non-ferrous ingot metals for Specification Purposes. C. M. SAEGER. *Proceedings Institute of British Foundrymen,* Vol. 27, 1933-1934, pages 268-304. See *Metals & Alloys,* Vol. 5, Sept. 1934, page MA 456. CEJ (11)

The Evaporation of Metals. A Correlated Abstract. L. R. JACKSON. *Metals & Alloys,* Vol. 7, June 1936, pages 160-161. Chart shows vapor pressure-temperature relations for 24 metals. Table gives purification possibilities by distillation of metals. 16 references. WLC (11)

Metallurgy of Powered Metals. HANS DIERGARTEN. *Metal Progress,* Vol. 29, Jan. 1936, pages 64, 66. Technique of preparation of powder, its consolidation, physical characteristics and applications of the resulting product are discussed. WLC (11)

Endurance Tensile Strength of Outdoor Construction Materials (Dauerzugfestigkeit von Freileitungsbaustoffen) Committee Report. *Zeitschrift für Metallkunde,* Vol. 28, Jan. 1936, pages 23-24. The "continued stress" (largest steady stress withstood for a year without fracture) of a number of metals has been measured in a 5 year program and the following average results obtained: (figures in kg./mm.²) Al = 12, hard Cu = 30, Aldrey = 24, Cu-0.7% Cd = 40, Cu-0.3 to 0.35% Mg = 50, Cu-3.25% Sn = 62, galvanized steels No. 40 = 32, No. 70 = 56, No. 120 = 90 and No. 150 = 110. The ratio of the tensile strength to the "continued stress" was found to be nearly constant for each metal but the ratio of the yield strength to the "continued stress" exhibited wide variations. FNR (11)

Thermal Conductivities of Metals and Alloys. J. W. DONALDSON. *Metallurgia,* Vol. 13, Mar. 1936, pages 159-160. Review of recently published data. 7 references. JLG (11)

11a. Non-Ferrous

A. J. PHILLIPS, SECTION EDITOR

Copper-zinc-tin Bearing Metals (Lagermetalle auf Kupfer-Zink-Zinn Grundlage) F. HANSEN. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, June 27, 1936, pages 807-808. Bearing alloys with 59.9% Cu, 34% Zn, 4% Sn, 0.6% Si and 1.5% Ni; 78% Cu and 22% Sn; 83% Cu, 14% Sn, 2.5% Pb and 0.5% Ni; and 62% Cu, 30% Zn, 4% Sn, 2.5% Pb and 1.5% Ni were used satisfactorily particularly as bearings in machine tools, roll neck bearings, textile machinery and gears. They can be cast and do not show undue shrinking. The high Zn content is, contrary to previous views, not at all injurious. Melting temperatures for Cu alloys with 28-33% Zn, 3-5% Sn and some Pb and Ni should be 884°-908° C. Tensile strength is 25-35 kg./mm.², yield point 18-22 kg/mm.², elongation 20-10% and Brinell hardness 90-110. Tubes can be made from these alloys by extrusion. Ha (11a)

Thermal-Conductivity of Some Piston Alloys at High Temperatures (Über das Wärmeleitvermögen einiger Kolbenlegierungen bei höheren Temperaturen). F. BOLLENRATH & W. BUNGARDT. *Metallwirtschaft,* Vol. 15, Apr. 17, 1936, pages 368-370. An apparatus for the determination of thermal conductivity is described, in which errors due to radiation losses are reduced by means of auxiliary heating elements, so that measurements can be made up to 400° C. with an estimated error of 7%. Results are tabulated for 6 different Al piston alloys at 50° intervals from 50° to 350° C., all showing a constant temperature coefficient within this range. A forged alloy was superior to a cast sample of the same composition, the Al-Cu alloys were all better than the Al-Si alloys, and Mn lowered the conductivity appreciably. GD (11a)

Magnesium—Lead Alloys. K. V. PEREDELSKII. *Legkie Metallui,* Vol. 4, Dec. 1935, pages 43-48. In Russian. The addition of 1-20% Pb to Mg increases the tensile strength, hardness, and resistance to corrosion. These alloys can be cast and cold-worked. An alloy containing 3.87% Pb has a tensile strength of 16.4 kg./mm.² and an elongation of 7.9% in the cast condition. HWR (11a)

Alumag, Al-Mg Alloy Resistant to Corrosion (Alumag Alliage Aluminium-magnesium resistant à la corrosion) H. ROGEZ. *Métaux,* Vol. 10, Dec. 1935, pages 358-368. Mg forms with Al a solid solution which is homogeneous and stable at all temperatures for Mg content less than 14%. High resistance Alumag has resistance to rupture of 4 kg./mm.² and 27-30% elongation. GTM (11a)

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The Bactericidal Action of Pure Metals and Metal Fillings. Mary S. Sheppard. *Dental Cosmos,* Vol. 77, Oct. 1935, pages 968-975. Information regarding the bactericidal action of metal fillings and the recurrence of caries adjacent to the fillings. Pure Au, Ag, Cu, Hg, gold and amalgam fillings were studied with reference to their action on cultures of L. acidophilus, Staphylococcus aureus, yeast, and mouth organisms. Pure Cu and Hg showed definite bactericidal properties; some of the gold and amalgam fillings showed bactericidal action, while others were slight inhibitors and still others showed no effect. Pure Au and Ag were without effect or even favored bacterial growth. Amalgam fillings, which had been removed from teeth with recurring caries, showed bactericidal properties. Thus the relation between bactericidal action and recurrence of caries was definite. 12 references. OEH (11a)

Electrical-Resistance Alloys of Copper, Manganese, and Aluminum. James L. Thomas. *Bureau of Standards Journal of Research,* Vol. 16, Feb. 1936, pages 149-159. An investigation has been made of the electrical properties of alloys containing from 4 to 15% Mn and from 0 to 10% Al, the remainder being Cu. An alloy containing 85% Cu, 9.5% Mn and 5.5% Al has properties very similar to those of manganin. Its thermoelectric power against Cu is much smaller than that of manganin and this thermoelectric power may be brought to zero by the addition of a very small amount of Fe. Resistance coils constructed from these alloys, with or without added Fe, have been very stable in resistance. By proper baking, their temperature coefficients of resistance at 25° C. may be made as nearly zero as desired, and this coefficient changes less with temperature than does that of manganin. WAT (11a)

Tellurium Lead. *The Dutch Boy Quarterly,* Vol. 14, No. 2, 1936, pages 9-11. Tellurium leead is practically pure Pb with only 0.1% Te or less, which, however, effects a marked change in physical structure in that it produces a finer and more uniform grain size. The resistance to corrosion, even under elevated temperatures and where vibrations are present is very high, and the tensile strength is claimed to increase when the metal is strained. Due to the acid resistant property the material is used for tank linings in the chemical industry and for pipes. It will stand hot H_2SO_3 and H_2SO_4 at 160°180° F. It can be worked as ordinary Pb. Ha (11a)

The Influence of Gases on Mercury Emulsions Prepared by Ultrasonic Waves. C. Bondy & K. Söllner. *Transactions Faraday Society,* Vol. 31, June 1935, pages 843-846. Hg is emulsified by ultrasonic waves in the same way as by shaking. The mechanism consists in the bursting of bubbles of the second liquid coated with thin films of Hg. Adsorbed gases stabilize Hg emulsions. The concentration of the emulsions formed in different liquids depends upon the stabilizing properties of the dispersion medium. 12 references. PRK (11a)

Beryllium-Copper Wire has unique Characteristics. J. Delmonte. *Wire & Wire Products,* Vol. 11, July 1936, pages 326-327, 355. Be-Cu with 2-2.5% Be is the highest strength Cu available after work-hardening and heat treatment at 800° C. with subsequent quenching. Curves show the effect of small Be additions on electrical conductivity which is markedly lowered, from 2 to 15%. The yield point of heat treated Be-Cu lies at about 135,000 lbs./in.², tensile strength at about 180,000 lbs./in.², and elongation (in 2") is 2-6%. Be-Cu is replacing phosphor bronze wire. If it is desired to soften Cu-Be wire for forming operations it is heated to 800° C. for about 1 hr. and immediately quenched in cold water. Such wires are used for weaving wire cloth. Ha (11a)

Deformability of Aluminum as Dependent on Purity (Beitrag zur Kenntnis des Formänderungsvermögens des Aluminiums in Abhängigkeit vom Reinheitsgrad) W. Helling. *Aluminium,* Vol. 18, July 1936, pages 307-309. Al rods of 99.3 to 99.977% purity were rolled and drawn and tensile tests made in different stages of the deformation. A table shows tensile strength, Brinell hardness, elongation at fracture, and reduction of area. Quite generally, the deformability of Al increases with increasing purity. Ha (11a)

The Casting and Treatment of Magnesium Alloys. A. J. Murphy. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 108-110. Author discusses in a general manner the foundry technique and heat treatment of some of the Mg-base alloys known as "Elektron A 8" and "A Z 91." This includes the approx. composition and physical properties. Corrosion resistance of Mg-base alloys, including results obtained in some laboratory tests, are considered. Some new applications of Elektron castings are mentioned. HBG (11a)

Manufacture of Sheet Silver. Mechanical Properties of Sheets of Commercial Silver Alloys as Dependent on Manufacturing Process (Die Herstellung von Silberblech. Die Festigkeitseigenschaften von Blechen technischer Silberlegierungen in Abhängigkeit von der Herstellungsart) H. Moser & E. Raub. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 10, May/June 1936, pages 19-27. The effect which shape of casting, hot-forging, and oxide film have on the quality of Ag sheet was investigated. The tests were made with sheets of different fineness, and while definite conclusions could not be drawn the results showed that, in general, sheet made from flat bars of 835 fineness usually has a higher tensile strength and yield point but lower elongation than sheet made from round bars of the same fineness; the difference in quality disappears, however, with increasing degree of working. The same holds good for the 925 alloy for elongation, but the tensile strength was lower for hot-forged sheets than for rolled sheets. The oxide film from annealing did not exert a definite effect on mechanical properties as long as it was of usual thinness. Ha (11a)

Some Peculiarities of Electrolytic Metals (Quelques particularités des métaux électrolytiques) Ladislav Jenicek. *Revue de Métallurgie,* Vol. 33, June 1936, pages 371-378. Heavy electrolytic deposits of Cr, Ni, Cu and Fe were studied dilatometrically and by hardness determination. Hardness of the deposits is reduced with the drawing temperature which, in the case of Fe and Cr, is associated with contraction amounting to slightly less than 1%. The phenomenon is due to H removal. Best etching of Cr was obtained by using 30-40% boiling HCl in which Cr is made cathode. The action is completed in 5-8 seconds. After drawing to 1000° C. the hardness of Cr could be reduced to 230-250 Brinell. JDG (11a)

11b. Ferrous

V. V. KENDALL, SECTION EDITOR

"4640" the Unknown. E. F. Davis. *Automotive Industries,* Vol. 75, July 18, 1936, pages 90-93. The medium C Ni-Mo steel, classified as S. A. E. 4640, has been found superior to any other oil hardening gear material by one leading gear company. A Ni content of 1.65-2.00% and Mo from 0.20-0.30% are preferred. High tensile properties, over 290,000 lbs./in.² ultimate, 180,000 lbs./in.² yield, and 10-12% elongation, are obtained, as well as Izod impact values of 5 to 6 ft.-lbs. This steel is also characterized by high fatigue resistance, a wide heat treating range, good surface hardness and minimum distortion in heat treatment. It is recommended for use in gears, transmission shafting, synchronizing collars, clutch shells, side plates, high tension bolts and the like. BWG (11b)

The Embrittlement of Alloy Steels. F. C. Lea & R. N. Arnold. *Proceedings Institution of Mechanical Engineeers,* Vol. 131, Nov.-Dec. 1935, pages 539-602. Researches to determine some of the conditions under which age embrittlement occurs due to stress and prolonged heating are described. It was found that steels with 3% Ni-1% Cr, with or without Mo, become embrittled under conditions of prolonged heating, whether stressed or unstressed. Embrittlement may occur with very little change in other properties. A theoretical investigation of tensile stresses in a necked tensile specimen is attempted to explain tensile stress fractures in embrittled steels. Tests and apparatus used are described. Ha (11b)

Alloys of Iron and Beryllium (Les Alliages de Fer et de Glucinium) J. Laissus. *Revue de Fonderie Moderne,* Vol. 30, Apr. 10, 1936, pages 121-123. Development of production of Be, its properties and present uses are briefly discussed. While Be alone does not seem to give to steel particular properties, the mechanical properties of alloy steels seem to be noticeably improved in presence of Ni and Cr simultaneously. An antimagnetic Ni-Mo steel with 1% Be was obtained. Ha (11b)

Austenitic Stainless Alloys; Their Properties and Characteristics. V. N. Krivobok & R. A. Lincoln. *Steel,* Vol. 98, May 11, 1936, pages 68. Abstract of paper read before interchapter meeting of American Society for Metals at Pennsylvania State College, May 1-2. Austenitic alloys which are fairly easy to decompose will have properties differing from those austenitic alloys in equilibrium. Manner of decomposition is of no consequence. By adjusting ratio of alloying elements, certain combinations of physical properties could be obtained which could not be found in alloy of another composition. Physical properties of these types of alloys bear no definite relation to their surface hardness. Original gives results of tests of effect of concentration of alloying elements on physical properties. MS (11b)

Replacement of Tungsten Magnet Steel with Chromium Steel Containing Molybdenum or Manganese. G. G. Livshitz & N. Ya. Drozdov. *Kachestvennaia Stal,* Vol. 4, No. 1, 1936, pages 56-61. In Russian. Steels containing: 1.00% C, 1.50 Mn, 8.16 Cr, 0.20 Si; 1.07 C, 0.34 Mn, 1.76 Mo, 9.68 Cr, 0.23 Si; 1.02 C, 2.28 Mn, 2.95 Mo, 2.53 Cr, 0.03 Si were investigated for their magnetic properties after different heat treatments. Magnetic properties obtained are calculated with the omission of demagnetizing factor of specimens. The steel with 1.0 C, 1.5 Mn and 8.0 Cr after oil quenching from 1175°, drawing for 1 hour at 600° and requenching in oil from 900° C. has $B_r \times H_c = 72 \times 10^4$ and steel with 1.0 C, 1.76 Mo and 9.7% Cr after quenching from 950°-1000° C. in oil has $B_r \times H_c = 74 \times 10^4$ which is equal to values obtained with W steels or slightly better. (11b)

Hot Working and Properties of Heat Resistant Cr-Mo Steel with an Increased Si Content. P. B. Mikhailov-Mikheev & A. I. Chishik. *Metallurg,* No. 2, 1936, pages 35-54. In Russian. A comprehensive investigation of steels having composition: 0.59% C, 0.60 Si, 14.6 Cr, 1.95 Mo; 0.60 C, 0.71 Si, 16.5 Cr, 1.65 Mo; 0.75 C, 0.90 Si, 17.0 Cr, 1.67 Mo. Their hot working characteristics, structure, mechanical properties, critical points, corrosion resistance, scaling resistance, strength at elevated temperature and fatigue resistance were studied. After quenching at 1050° C. and drawing, average tensile strength was 80-85 kg./mm.², yield point 55-60 kg./mm.², elongation 18-24%, reduction of area 45-55%, impact strength 2 kgm./cm.²/min. were obtained. These steels have chemical resistance equal to the usual Cr stainless steel but have a better scaling resistance than both 17% Cr and 14% Cr-1.5% Mo steels. It has a better fatigue limit and strength at elevated temperatures than 17% Cr stainless steel and sufficiently high ductility both in cold and hot states. Carbides, liquation and segregation are its drawbacks, which can be overcome by proper heat treatment. The steel is fully free from intercrystalline corrosion, not having any austenitic phase during usual heat treating operations. It might be used for heavily loaded parts operating at elevated temperatures. (11b)

Tungsten and Titanium Carbides (Les carbures de tungstène et de titane) *Journal du Four Electrique,* Vol. 45, June 1936, pages 200-201. This article erroneously states that stellites invented by Haynes are made by sintering tungsten carbides with Co at very high temperatures, since stellites are cast from the molten stage. Usual stellites have a composition: 1-4% C, 5-25% W, 20-25 Co, 20-30 Cr. They were further improved into a product containing 3.2-6% C, 83-97% W, 6% max. Co and are sold under the trade names of Widia, Carboloy, Titanit, etc. JDG (11b)

Steel Manufactured in France (Les Aciers de Fabrication Francaise) *Science et Industrie (Mecanique),* Vol. 20, Jan.-Feb. 1936, pages 38-41; Mar.-Apr. 1936, pages 54-62. The first installment discusses non-magnetic steel, and steels having a high permeability and low hysteresis. The second section deals with high elastic limit steels. All are discussed as to: (1) composition, (2) physical and mechanical properties at room and high temperature, (3) heat treatment, (4) corrosion resistance, (5) machining, (6) applications and (7) trade marks. FR (11b)

Influence of Casting Temperature and Cooling Speed on Mechanical Properties of Low Silicon Iron Castings. V. Ya. Romasheva. *Liteinoe Delo,* Vol. 7, No. 5, 1936, pages 28-32. In Russian. Cast Fe having aa composition 3.6-3.9% C, 0.8-1.2 Si, 0.6-0.9 Mn, 0.8 S max., 0.1-0.25 P was cast in green sand, dried and preheated molds and studied microscopically and by determination of physical properties. (11b)

Steel for Autoclaves. R. J. Sarjant & T. H. Middleham. *Iron & Coal Trades Review,* Vol. 133, July 3, 1936, page 11. The following results are reported from investigations into the behavior of steel for autoclaves. Mild steel suffered severe intergranular cracking at even comparatively low temperatures (325° C.) when the H pressure was 250 atm.; at 125 atm. the attack was greatly reduced. 2½% Cr steel withstood attack up to 550° C. and under 125 atm. but the steel was embrittled. 1% Cr-V steel was not severely attacked at 325° C. and 250 atm. At 550° C. embrittlement took place, but H caused, at 125 atm., only slight decarbonization. Cr-Al-Mo steel was unaffected by H up to 550° C. at 125 atm. and showed little embrittlement. Ni-Cr-Mo steel, under 250 atm., showed only slight H attack at 550° C., but severe attack at 750° C. Cu-Cr-Mo steel was immune from any deterioration up to 550° C. and under 250 atm., but serious intergranular cracking took place at 750° C. 6% Mn-Co steel was free from attack by H but suffered embrittlement at 450° and 550° C. under 250 atm. 13% Cr steel was entirely free from H attack under most extreme conditions but showed some slight embrittlement at 325° and 550° C. The more highly-alloyed austenitic steels did not indicate any H attack or embrittlement up to 750° C. Ha (11b)

Gases in Steel. T. Swinden. *Iron & Steel Industry,* Vol. 9, Dec. 1935, pages 100-106. Paper read before the Newport & District Metallurgical Society, Nov. 1935. It is probable that gases in themselves or gas reaction products, together with a control of the grain size are the determining factors in explaining most of the hitherto unexplained differences between steels of similar type (and similar ordinary analysis) on the one hand and between steels made by different processes on the other. The effect and methods of determination and control of O content are discussed. The effect of passing various gases such as H, N, H followed by N, CO_2 and CO, through liquid steel is reported. It is concluded (1) that the solid solubility of N and CO_2 is not seriously lower than the liquid solubility, and these gases are apparently inert under the experimental conditions recorded, (2) the solid solubility of H is considerably less and that of CO slightly less than the liquid solubility. CMS (11b)

An Investigation of Abrasion in Cast Iron. Masuhiro Suzuki. *Science Reports Tohoku Imperial University,* Vol. 24, Feb. 1936, pages 724-744. Measurements were made of the relative abrasion of gray cast Fe of different chemical composition and of samples that were cooled at various speeds, using apparatus previously described by the author (Vol. 17, No. 3, 1928). Abrasion of gray cast Fe was found to be affected by the composition but not much affected by the tensile and hardness properties. P caused the greatest increase in resistance to abrasion. Combined C tended to increase the abrasion resistance, especially when it was higher than 1.3%. Mn and S had little effect; Si and total C had only an indirect effect by influencing the amount of combined C present. A critical pressure was found to exist, above and below which the amount of abrasion differed considerably. The following equation is given for the relative abrasion of both C steels and cast irons: $W_{nm} = K \frac{W_{Nm}}{W_{Nn}}$ and $K = a\mu^2$. The symbols n, m and N represent any substance contained in cast irons or the C content of C steels. W_{Nm} = standard specific abrasion of a substance, m, with respect to a standard substance N. W_{Nm} = same as above for substance n. W_{nm} = relative specific abrasion between substances m and n. μ = coefficient of friction. a = constant, invariable for a series of substances having similar properties but varies when their properties differ widely. BWG (11b)

Nickel Plated Steel Sheets for the Chemical Industry (Nickelplattierte Stahlbleche für die chemische Industrie) B. Trautmann. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, June 20, 1936, pages 785-787. Properties of steel sheets which are plated on one or both sides (by rolling on) with layers of Ni, Monel metal and austenitic Cr-Ni steel of about 5-10% of the total thickness are discussed. The sheet is usually a mild steel of 32-50 kg./mm.^{2} tensile strength. The plated sheet shows an average of about 40 kg./mm.^{2} and elongation at rupture about 25%. The corrosion resistance is determined entirely by the plating; Ni and Ni containing alloys are practically proof against lyes, inorganic and organic acids, salts and salt solutions and food stuffs. Cold working can be done as with the unplated steel; the plated layer should be laid face upwards for protection from mechanical injuries. Annealing, if necessary, should take place between 870° and 930° C. for 1-3 min. Welding should be done with pure Ni electrode. Fields of application for such sheets are described. Ha (11b)

Carbon and Low-alloy Steels. E. F. Cone. *Steel,* Vol. 98, Mar. 9, 1936, pages 43, 45. Abstract of paper read before the American Society for Testing Materials. See *Metals & Alloys,* Vol. 7, Mar. 1936, pages 77-84. MS (11b)

Effect of Carbon, Oxygen and Grain-Size on the Magnetic Properties of Iron-Silicon Alloys. T. D. Yensen & N. A. Ziegler. *Transactions American Society for Metals,* Vol. 24, June, 1936, pages 337-358. Data presented at Chicago Convention of the Society, 1935, on these relations indicates that O_2 is without appreciable effect at low densities but does have an effect on the high density permeability of Fe-Si alloys. Effect of C is generally less and the effect of grain size generally more than previously indicated. Effect of various forms of C is confirmed. WLC (11b)

Tensile Strength and Brinell Hardness of Cast Iron (Zugfestigkeit und Brinellhärte von Gusseisen) A. Leon. *Zeitschrift Verein deutscher Ingenieure,* Vol. 80, Mar. 7, 1936, pages 281-282. The reliability of formulae for the determination of certain properties of cast Fe from one other characteristic value, e.g. tensile strength from Brinell hardness, or compressive from tensile strength, is discussed on the basis of a compilation of formulas developed by several authors and found to be of doubtful value. One single characteristic figure of cast Fe alone will not permit defining other properties reliably. 11 references. Ha (11b)

Beryllium-Iron Alloys. W. Kroll. *Metals & Alloys,* Vol. 7, Jan. 1936, pages 24-27. 11 references. 1% Be allows hardening of 18-8 stainless up to a Brinell of 675. Discusses Be as a desulphurizer of much greater power than Ca. WLC (11b)

Modern Developments in Stainless Steels. J. H. G. Monypenny. *Metal Treatment,* Vol. 2, Spring 1936, pages 24-28, 33. Martensitic stainless steels, which can be hardened and tempered, are used for cutlery, and have moderate corrosion resistance. They originally contained 0.3% C and 12-14% Cr. Greater corrosion resistance is obtained with 18% Cr plus 2% Ni. Ferritic steels (stainless Fe), used for fabrication, have up to 14% Cr and a minimum of C. If Cr is increased to 20%, improved corrosion resistance is obtained but only at the expense of notch toughness and a tendency to grain growth. Addition of Cu, however, increases the toughness. Ferritic steels with up to 30% Cr have good heat-resisting properties even in sulphurous gases. Austenitic steels with 18% Cr and preferably 8.5% Ni have very good corrosion resistance and are ductile. "Weld-decay" of 18:8 steels, and its partial prevention by keeping C below about 0.06%, by "stabilising" at 900° C (preferably after cold working), or by additions of Ti, Si, or Co are discussed. Additions of 1.5 to 2% of Si are not oxidized away during welding, increase corrosion resistance to acids, and are preferred. JCC (11b)

Heat Resisting Cast Irons. J. G. Pearce. *Metal Progress,* Vol. 29, Jan. 1936, page 63. Calls attention to appearance of description of 5.5% Si, 10% Al, 2.5% C Fe in *Journal Iron & Steel Institute,* Vol. 125, 1932, pages 392-426 and of the austenitic cast Fe in same journal, Vol. 126, 1932, pages 301-322, also *Transactions American Foundrymen's Association,* Oct. 1933, page 261. This was prior to Thyssen's investigation described by Portevin, *Metal Progress,* Vol. 28, Nov. 1935, pages 67-68. WLC (11b)

The A-B-C of Corrosion and Heat Resistant Steels. F. M. Palmer. *Metal Progress,* Vol. 29, Feb. 1936, opposite page 48. Tabulation of various properties of martensitic, ferritic and austenitic steels for these services. WLC (11b)

Chromium Cobalt Magnet Steel with Low Cobalt Content. V. A. Erakhtin. *Kachestvennaia Stal,* Vol. 4, No. 1, 1936, pages 49-55. In Russian. A steel with 0.95% C, 5.80 Cr and 6.05 Co was investigated. Deterioration in magnetic properties occurs as a result of carbide decomposition which does not take place under 700° C., but is pronounced between 700° and 1100° C., the maximum being at 800° C. Optimum quenching temperature is 950° C., but the time must not be too long, 5-10 minutes being the proper range. Any previous deterioration can be remedied by heating to 1180°-1200° C. followed by rapid cooling. After a proper treatment the steel gives $H_c = 90 — 100$, $B_r = 9500 — 8500$. (11b)

Progress in Special Steels. Robert Hadfield. *Blast Furnace & Steel Plant,* Vol. 24, Mar. 1936, pages 221-223; Apr. 1936, pages 308-309. Part of a paper read before the 7th International Congress of Mining, Metallurgy and Applied Geology. See "Recent Advances in Alloy Steels," *Metals & Alloys,* Vol. 7, July 1936, page MA 368L/1. MS (11b)

The Production of Specially Hard Cast Irons for Alloying and Heat-Treatment. W. T. Griffiths. *Proceeedings Institute of British Foundrymen,* Vol. 27, 1933-1934, pages 563-587. See *Metals & Alloys,* Vol. 6, Mar. 1935, page MA 120. CEJ (11b)

Method for Comparing Properties of Heat Treated Structural Alloy Steels (Méthode de comparison des caractéristiques mécaniques des aciers spéciaux de construction traités) Francois le Chatelier. *Revue de Métallurgie,* Vol. 33, May 1936, pages 338-344. Proposes methods for comparison of alloy steels from the standpoint of their physical properties in which ratios of physical properties such as tensile strength-ductility ratio, etc., are considered rather than single characteristics. JDG (11b)

Stainless Steels and Weld Decay. H. Bull. *Sheet Metal Industries,* Vol. 10, Mar. 1936, pages 251-253. From a paper before the Royal Aeronautical Society in Manchester. Discusses the development of stainless steels. Methods of controlling the tendency to "weld decay" are treated. These are, reducing the C to 0.07% or less, adding about 1.0% W, adding about 0.6% Ti or V, or adding about 2.0% Si. AWM (11b)

Influence of Grain Size and Alloying Elements on the Quality of Steel. E. C. Bain. *Kachestvennaia Stal,* Vol. 4, No. 1, 1936, pages 23-34. In Russian. A translation of paper presented at Moscow. A summary of results already published. (11b)

Some Forging Copper Steels Susceptible to Structural Hardening (Quelques aciers de forge au cuivre susceptible d'un durcissement structural) L. Faure. *Revue de Métallurgie,* Vol. 33, May 1936, pages 331-337. In Cu bearing steels Cu precipitates from solid solution and rapidly coalesces at 650° C. On heating in an oxidizing atmosphere it accumulates on the surface of the metal under the scale and at a temperature above 1100° C. diffuses along grain boundaries causing red shortness. Cu-Cr-Fe alloys with Cu more than 0.6 and Cr around 0.5% behave as Cu steels. Ni additions raise melting point of Cu inhibiting the intergranular penetration of Ni-Cu alloy. Cu goes into solution in Cu-Cr and Cu-Ni steels of this composition between 680° and 750° C. In order to produce precipitation hardening cooling between 680° and 615° C. has to be at least 100° C. per hour. Precipitation hardening by drawing at 500° C. produces an increase in elastic limit, tensile strength and elastic limit curves being directly proportional to Cu content. The speed of reaching a maximum strength increases up to 0.7% Cu, the minimum content practical for commercial use. About 10 kg./mm.^{2} strength increase can be produced by these means. The method helps to obtain high elastic limits in annealed steels by using high Cu metal. JDG (11b)

Mechanical Properties of Muntz Metal LS-59 in Relation to Copper Content. P. I. Gradusov. *Tzvetnuie Metallui,* May 1935, pages 103-112. In Russian. Experiments were made on several compositions of Muntz metal with Cu varying from 57 to 61%, and Pb from 0 to 1%. Data are given illustrating effect of composition, treatment, hot and cold working, degree of reduction, etc. on the structure and mechanical properties of the alloys. BND (11b)

Effect of Iron Impurities on the Annealing of High Brass. W. A. Gibson & J. H. Doss. *Industrial Heating,* Vol. 3, July 1936, pages 443-446. The effect was studied at temperatures from 600°-1200° F. and for Fe impurities from 0.008-0.287%. Experiments and results are described in detail from which it is concluded that Fe impurities up to 0.09% are not harmful to annealing, that between 0.09 and 0.118% a great discontinuity occurs, and that presence of Fe greater than 0.118% is not harmful to sheet brass if properly manufactured and annealed under correct conditions. Ha (11a)

Making Tubing of High Strength Light Alloys. M. I. Kovarski. *Metallurg,* Vol. 11, June 1936, pages 96-101. In Russian. A series of experiments of adjusting composition and heat treating cycles resulted in an alloy which has 47 kg./mm.^{2} tensile strength and 10% elongation after being formed at 440°-460° C. and quenched at 505° ± 3° C. Its composition is: 4.6-6.0% Cu, 0.8-1.2 Mn, 0.65-1.5 Mg, 0.7 Si max, 0.5 Fe max. and 0.2 Ti max. (11a)

The Effect of Oxygen on the Clean Up of Phosphorus Vapour by Tungsten Filaments. H. W. Melville & S. C. Gray. *Transactions Faraday Society,* Vol. 32, July 1936, pages 1020-1025. Covering a filament with a layer of O atoms completely inhibits the dissociation of P_4 molecules upon it. It appears that the dissociation on a partially oxidized filament occurs wholly on the clean W surface. Measurement of the half-life for the P_4 — O_2 reaction and for the P_4 clean up shows the former to be much slower. In the P_4 — O_2 reaction, the W surface is covered with a layer of P on top of which are O atoms or molecules. 6 references. PRK (11a)

Alloying Aluminum. M. I. Zakharova. *Metallurg,* No. 2, 1936, pages 92-101. In Russian. Effect of different alloying elements on Al. Generalization of the mechanism of their action taken from literature. (11a)

Static Mechanical Properties of the German Standardized Tin Bronzes (Phosphorbronzes) in Cast (both as Cast and Annealed) State at Room Temperature and Elevated Temperatures (Die statischen Festigkeitseigenschaften der deutschen, genormten Zinnbronzen (Phosphorbronzen) in gegossenem (ungeglühtem und geglühtem) Zustand bei Raumtemperatur und Höheren Temperaturen) W. Claus & C. Goetzel. *Giesserei,* Vol. 23, Mar. 27, 1936, pages 154-158; Apr. 24, 1936, pages 206-219. The standard Sn bronzes WB_z6, GB_z10, GB_z14 and GB_z20 were studied in the as cast state and after annealing; the change in chemical analysis was determined in several stages. The Sn content of the 4 samples was 5.45, 9.09, 13.9 and 19.95% respectively, remainder Cu and 0.012-0.038% P. Bronze WB_z6 shows no difference in mechanical properties between as cast and annealed specimens. GB_z10 and, for all practical purposes, also GB_z20, behaved similarly. GB_z14, however, had in the as cast state, at room temperature low tensile strength and elongation. Elasticity modulus and Brinell hardness were higher in the as cast than in the annealed specimen. All properties decrease with increasing temperatures, both for the annealed and as cast state. The effect of using scrap in preparing casting is discussed. Results of all tests are recorded in 3-dimensional diagrams. 9 references. Ha (11a)

Influence of Additions on Properties of Magnesium Alloys. N. V. Ageew, M. I. Zamotorin & D. N. Shoykhet. *Metailurg,* No. 3, 1936, pages 27-47; No. 4, 1936, pages 4-59. In Russian. Influence of additions to Mg alloys containing respectively: 9.85% Al, 0.15 Mn, 0.09 Fe, 0.02 Cl; 6.03 Al, 2.98 Zn, 0.18 Mn, 0.02 Fe, 0.02 Cl and 10.14 Al, 1.04 Cu, 0.04 Si, 0.02 Fe, 0.03 Cl in the cast state and those containing 4% Al, 3 Zn, 0.2 Mn; 6 Al, 1 Zn, 0.2 Mn and 1.5 Al, 4.5 Zn, 0.75 Cu in rolled state were studied. Above alloys were melted in Fe crucibles under 30% KCl-70% $MgCl_2$ flux with the addition of proper elements cast into chills heated to 200° C. and the ingots split longitudinally. One half was aged, another used for physical testing as cast. Specimens of rolled stock were prepared by rolling these ingots into 3 mm. sheets. They were studied in "as rolled" state. Si increases gas absorption, liquation and shrinkage. It hardens and embrittles the alloys helping simultaneously the aging process. Mechanical characteristics of alloys change with temperature inversely proportionally to Si content. Fe can dissolve in these alloys up to 0.2% decreasing shrinkage. Hardness and strength are raised by it though it has no effect on aging and rolling properties. Na up to 1% decreases shrinkage, decreases strength both at room and elevated temperatures, particularly impact strength. It increases porosity and does not have any effect on aging. Na has the most pronounced deleterious influence on mechanical properties of these alloys, 0.9% Na reducing ductility to zero, and greatly lowers tensile strength. With 0.06-0.09% Na metals are hot short. It reduces aging. K lowers mechanical properties but has no influence on rolling and aging characteristics. Ca is a good deoxidizer and its presence up to 1% does not have a pronounced influence on mechanical properties. Magnesia reduces liquation, shrinkage and crystallization. With its content up to 0.1% almost no changes in physical properties are observed. When it passes this limit all mechanical properties drop. MgO does not affect aging. (11a)

The Catalytic Decomposition of Hydrogen Peroxide on Different Metals. Joseph Weiss. *Transactions Faraday Society,* Vol. 31, Nov. 1935, pages 1547-1557. The initial process of the catalytic decomposition of H_2O_2 by metals involves an electron transfer from the metal to H_2O_2 adsorbed on the surface. The radicals OH or HO_2 are formed and the chain reaction of the catalysis proceeds. The catalytic decomposition on Pt, Au, Pd, Ag and Zn has been investigated in detail. 20 references. PRK (11a)

Electrode Dispersion of Noble Metals. Andr. Voet. *Transactions Faraday Society,* Vol. 31, Nov. 1935, pages 1488-1491. When electrodes of noble metals are electrolyzed with a high current density and a high potential difference in alkaline, acid, and neutral solutions, a disintegration of the anode occurs with the formation of unstable suspensions. Such dispersion is accompanied by frequent pulsations. To obtain electrode disintegration for every potential difference a minimum concentration of electrolyte is required such as, .3 *N* H_2SO_4 and .2 *N* $(NH_4)_2SO_4$ for Au at 110 volts, 1.5 *N* H_2SO_4 for Pt at 110 volts. The electrode dispersion may be explained as the result of the repulsion of a periodically formed oxide layer on the surface of the anode. The Wehnelt effect, which is a sudden fall of the strength of current to about 1/10 value accompanied by small sparks and peculiar crackling, is not the cause of the electrode dispersion. 6 references.

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On the Longitudinal Magneto-Resistance Effect at Various Temperatures in Nickel-Copper Alloys. Hakaru Masumoto & Yuki Shirakawa. *Science Reports Tohoku Imperial University,* Vol. 25, Apr. 1936, pages 104-127. Resistance changes of Ni-Cu alloys were measured at temperatures from —195° to 400° C. up to 1600 oersteds. Form of magneto-resistance-temperature curve was found to be the same as that of Ni; however, the resistance change of Ni was found to increase by addition of Cu, rapidly at first to a maximum (most pronounced at low temperatures) then to decrease until axis of concentration was crossed. Intensity of magnetization of Ni decreased steadily by Cu additions, becoming zero at the concentration point where a change took place from ferro to para-magnetic state. BWG (11a)

Magnesium and Ultra Light Alloys (Le Magnesium et les Alliages Ultra-Legers) Henri Portier. *La Technique Moderne,* Vol. 28, May 1, 1936, pages 313-320; June 15, 1936, pages 435-439. (1) Forging of Mg alloys is explained and works of de Fleury, Gris and Precoul are discussed. (2) Drop forging is said to be easy with Mg alloys. (3) Rolling must be thoroughly controlled. Reductions which are initially about 25% must later be decreased. Zn improves ductility of Mg alloys. Some alloys containing Cd are easily rolled. Al additions increase strength of alloys. Al + Ce additions give alloys of medium strength but of high ductility. (4) Extrusion is the only practical process for manufacturing bars, tubes and profiles with Mg alloys, and is performed at a low temperature (320° C.). (5) Bending and shaping of Mg alloys: It is good practice to anneal sheets at 300° C. Cold working is not advocated, shaping is preferably between 270° and 320° C. (6) Riveting is done cold with Al alloys containing 5% Mg. (7) Welding: torch welding is done without difficulty. Chief point is to avoid flux entrapments in the welds. Electric arc and spot welding can also be used. (8) Machining of Mg alloys is very easy: angle of cutters and other particulars are given for each type of machining. Second section of paper is very theoretical and is devoted to study of mechanical strength. Formulas and graphs are given. The second article deals with applications of Mg alloys. (1) Chemical applications: Mg is widely used in other alloys such as duralumin and Y alloy. (2) Physical or mechanical applications: most valuable property of Mg alloys is low density and applications are numerous where minimum weight is desired. (a) Aircraft engineering: typical parts made of Mg alloys are motor crankcases, pistons, screw propellers, landing devices, tanks, brake jaws, wheel stream lined casing, bearings, levers, doors, window-frames, etc. (b) Automobile and bicycle industries; typical parts made of Mg alloys are: motor crankcases, rear-axle casings, tanks, wheels, and numerous accessories. In light car construction Mg alloys are not yet used owing to their high price. (c) Other industries: Mg alloys are used in textile, electrical, radio, railway industries, etc. FR (11a)

The Determination of the Viscosity of Liquid Gallium Over an Extended Range of Temperature. K. E. Spells. *Proceedings Physical Society,* Vol. 48, Mar. 1936, pages 299-311. The viscosity of Ga, determined by a quartz capillary viscometer made to fit inside a tubular furnace, was found to vary from 0.02037 poises at 30° C. to 0.005783 at 1100° C., following Andrade's equation closely. All measurements were made *in vacuo.* By introducing a little dilute HCl before evacuation, the tendency of Ga to stick to quartz was overcome. JCC (11a)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

Embrittlement of Alloy Steels Caused by Long Heating. A. M. Borzdika & S. I. Wolfson. *Kachestvennaia Stal,* Vol. 4, No. 2, 1936, pages 17-24. In Russian. Heating at 400°, 500°, 600° and 700° C. for 500 hours followed by heating to the temperature for a day and keeping at room temperature for a day repeated 82 times (4000 hours) was applied to the following steels: (1) 0.10-0.17% C, 3.40-4.00 Ni. 0.75-1.10 Cr; (2) 0.40-0.50 C, 0.20 Ni, 1.0-1.5 Cr; (3) 0.13 C, 5.8 Cr; (4) 0.16 C, 5.6 Cr, 0.65 Mo; (5) 0.2 C, 5.75 Ni, 19.2 Cr. Embrittlement was determined by microscopic examination, hardness determination and Charpy impact testing. C-Cr steel did not show embrittlement between 375°-615°. Ni-Cr showed distinct brittleness after heating at about 500° C., but heating at 600° C. increased its toughness. The 6% Cr steel heated around 500° C. gave exceptionally scattered results, though continuous heating at 600° C. lowered the original toughness but little. Addition of Mo to this steel eliminated the influence of heating on its toughness. Embrittlement is not directly connected with changes in hardness, nor is there any relation between microscopic appearance and embrittlement. Austenitic steels became brittle after even comparatively short heating at above 400° C. (12)

Industrial Experience Regarding Strength of Steels Permitting High Superheat (Experience industrielle sur la résistance des aciers permettant d'atteindre de très hautes surchauffes) Jean Dauvergne. *Revue de Métallurgie,* Vol. 33, May 1936, pages 325-330. A boiler installation is described in which different types of steel were used for superheater tubes. The compositions were: 0.47 Cr, 0.44 Mo; 0.41 Cr, 0.44 Mo, 0.75 Al; 5.25 Cr, 0.60 Mo; 4.86 Cr, 0.66 Mo, 0.57 Al; 10.62 Cr, 0.27 Mo, 0.97 Al; 15.35 Cr, 7.82 Ni. Visual examination after 10,000 hrs. at 560° C. and with speed of steam 11.6 m./sec. showed that all tubes withstood this service satisfactorily. JDG (12)

Some Experience in Developing Creep Testing Methods. P. B. Mikhailov-Mikheev & G. M. Denisov. *Metallurg,* No. 3, 1936, pages 47-60. In Russian. Mechanical features and experimental procedure adopted for the only creep testing installation in Russia. Metropolitan-Vickers type of design was adopted, but the installation was not operated long enough to warrant definite conclusions. (12)

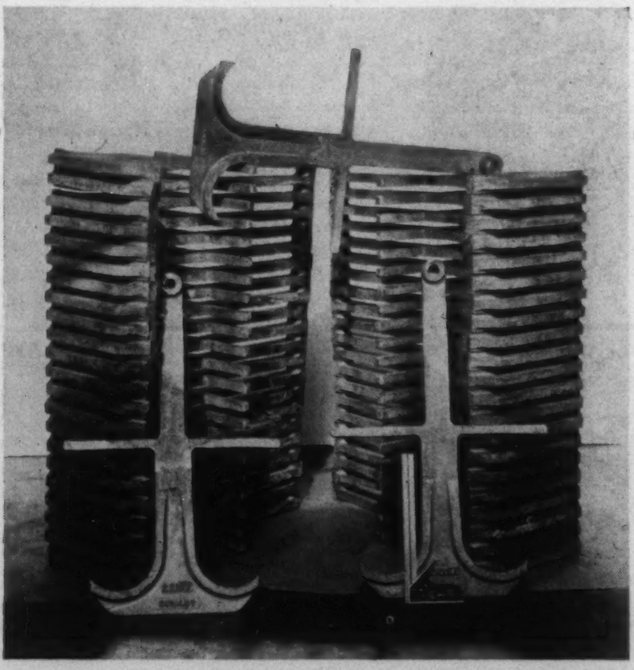
2 **Determination of Creep Strength (Ermittlung der Dauerstandsfestigkeit)** H. Schmitz. *Zwanglose Mitteilungen des deutschen und oesterreichischen Verbandes für die Materialprüfungen der Technik* No. 28, May 1936, pages 409-412. The methods used for determination of creep strength are discussed with regard to their practicability; in order to be used in routine practice they should be simple and convenient in the normal operation of a plant, the time must be not longer than 50 hrs. under normal load, and the evaluation of the test results must not be complicated and give no ambiguous values. Practices developed in different countries and the regulations adopted are reviewed. A few examples illustrate satisfactory tests. Ha (12)

3

The Utilization of Creep Test Data in Engineering Design. R. W. Bailey. *Proceedings Institution of Mechanical Engineers,* Vol. 131, Nov.-Dec. 1935, pages 131-269; discussion, pages 269-349. Experimental data were obtained from the creep of Pb and steel tubes under compound stress in order to provide a rational basis for the design of parts operating under creep conditions. The theories involved are developed and distribution of stress and creep under compound stress determined in rotating disks and other important engineering parts. See also *Metals & Alloys,* Vol. 7, May 1936, page MA 261L/6. Ha (12)

4 **Some Tests of Tin Bronzes at Elevated Temperatures.** J. W. Bolton. *Foundry Trade Journal,* Vol. 54, Apr. 9, 1936, page 287. Abstract of paper presented to the American Society for Testing Materials. See *Metals & Alloys,* Vol. 6, Dec. 1935, page MA 511R/2. AIK (12)

Physical Properties of Metals as Affected by Conditions of Ammonia Synthesis. H. L. Maxwell. *Transactions American Society for Metals,* Vol. 24, Mar. 1936, pages 213-224. Paper and discussion from the Chicago Convention of the Society 1935. Deoxidized Cu and Cu alloys are more resistant to high temperature, high pressure H_2-N_2 mixtures than similar alloys containing oxide. 5 Plain C steel and low Cr-Ni alloys are severely embrittled up to 500° C. in contact with 3:1 H_2-N_2 mixtures at 1000 atm. Cr-W, Cr-Mo, and Cr-V steels show increased resistance to gas attack for times up to 1535 hrs. WLC (12)



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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

A Comparison of Certain Metals regarding their Resistance to Corrosion by a Natural Strong Brine Water. Harold B. Salt. *Chemistry & Industry,* Vol. 55, July 17, 1936, pages 205T-207T. A study of the corrosion resistance of a large number of metals and alloys to the corrosive action of natural brine water. Metals in the following groups were tested: (1) Cu alloys in which the Cu content ranged from 71-96% with varying percentages of Zn, Al, Sn, Ni and Fe; (2) Ni alloys in which the Ni content ranged from 20-68% with varying percentages of Cu, Cr, Zn, Fe and some having traces of Si and Mn; (3) stainless steels in which the Cr content ranged from 12-18%, the Ni content 8-12%, Fe from 74-76%. Several of the alloys in this group contained the stabilizing elements Mo, Ti, W and Co; (4) pure metals as Al, Cr, Cu, galvanized Fe, Ni, Sn, Zn, Pb, Fe (cast and rolled), and tool steel. 4 tables of data are given.
AAA (13)

Influence of Impurities on Oxidation of Copper at Elevated Temperatures. S. P. Gvozdov & N. N. Nagornov. *Metallurg,* Vol. 11, June 1936, pages 78-82. In Russian. Strips of pure Cu were suspended in a vertical tube furnace provided with a trap door at the bottom. After heating to proper temperature for the desired time the door was opened and specimen rapidly transferred into water. Amount of oxidation was determined by weighing both specimen and scale which separated from its surface. The results are in good accord with data of N. B. Pilling & R. E. Bedworth, *Journal Institute of Metals,* Vol. 29, 1923, page 529.
(13)

Korrosion IV. VDI Verlag, Berlin, 1935. Paper, 6¾ x 8¼ inches, 76 pages. Price 5 RM.

A collection of papers presented at the Symposium on Corrosion, Nov. 20, 1934, under the auspices of the Verein deutscher Eisenhüttenleute, Verein deutscher Chemiker, Deutsche Gesellschaft für Metallkunde and Verein deutscher Ingenieure. The papers have been abstracted individually in *Metals & Alloys* as indicated: Carl Carius, Die Korrosion der Metalle in Wasser und wässrigen Lösungen, pages 1-8 (*Metals & Alloys,* Nov. 1935, page MA 463L/4). H. Steinrath & H. Klas, Bodenkorrosion von Rohren und Schutzmassnahmen gegen sie, pages 9-21 (*Metals & Alloys,* Nov. 1935, page MA 463L/1). Franz Eisenstecken, Korrosion im Innern von Wasserleitungen und deren Verhütung, pages 22-31 (*Metals & Alloys,* Dec. 1935, page MA 512R/8). Walther Wunsch, Korrosion im Innern von Gasleitungen und deren Vermeidung, pages 32-37. (*Metals & Alloys,* Nov. 1935, page MA 462R/7). M. Mengeringhausen, Einfluss der Betriebsbedingungen auf die Warmwasserbereiter, pages 38-47 (*Metals & Alloys,* Nov. 1935, page MA 462R/9). Max Brandt, Vermeidung der Korrosion in Warmwasserbereitern durch bauliche Massnahmen, pages 48-54 (*Metals & Alloys,* Nov. 1935, page MA 463L/8). Erich Naumann, Vermeidung der Korrosion in Warmwasserbereitern durch Wasserbehandlung, pages 55-60 (*Metals & Alloys,* Dec. 1935, page MA 514L/9). Wilhelm Blum, Korrosion in Heizungsanlagen, pages 61-62 (*Metals & Alloys,* Nov. 1935, page MA 463L/7). Gustave Tichy, Verhalten von Vorkriegs- und Nachkriegsstahl in Warmwasserbereitern und Heizungsanlagen, pages 63-72 (*Metals & Alloys,* Nov. 1935, page MA462R/6). Walter Schneider, Erkenntnisse und Forschungsaufgaben auf dem Gebiete des Korrosionsschutzes von Rohren, pages 73-76 (*Metals & Alloys,* Dec. 1935, page MA 514L/7).
V. V. Kendall (13)—B—

Measuring Unit for Corrosion (Masseinheit für Korrosion. DIN E 4851) F. Tödt. *Aluminium,* Vol. 18, Apr. 1936, pages 133-134. The committee on corrosion has drawn up a plan for testing materials for corrosion, treatment of specimens and comparison of results. Analytical and constructive units are distinguished: the former is the loss in weight in g./m.²/day, the latter the decrease in thickness in mm./yr.
Ha (13)

The Modern Theory of Corrosion. W. W. Kittelberger. *American Paint Journal,* Vol. 20, June 29, 1936, pages 23-24, 26, 54, 56, 58. A brief discussion of the electrochemical theory of corrosion. Corrosion is classified as: (1) corrosion by direct chemical attack, (a) in the absence of water, (b) in the presence of water; (2) corrosion in which the dissolving metal displaces another metal from solution, (3) corrosion in which the dissolving metal displaces H from solution, (a) H is visibly evolved, (b) H is not visibly evolved because the discharge potential of H on the cathode surfaces is greater than the potential of the dissolving metal. Anodic control and the use of chemical inhibitors are discussed.
WHB (13)

The Rate of Solution of Copper in Dilute Aqueous Reagents. Cecil V. King & Lillian Weidenhammer. *Journal American Chemical Society,* Vol. 58, Apr. 1936, pages 602-607. The rate of solution of polycrystalline Cu from a rotating cylinder has been measured in solutions of acetic acid and various oxidizing agents. It is concluded that the rate of solution in the ferric salt solutions is largely diffusion-controlled. In the acetic acid solutions the rate may be entirely or partly controlled by the rate of the chemical reaction; in some of these solutions surface coatings may mechanically prevent access of reagent to the Cu surface or otherwise change the nature of the reaction.
MEH (13)

Action of Cream and Butterfat on Metals and the Influence of Metals on the Quality of Butter and Butterfat (Die Einwirkung von Rahm und Butterfett auf Metalle sowie die Qualitätsbeeinflussung von Butter und Butterschmalz durch Metalle) W. Mohr & A. Eichstädt. *Molkerei-Zeitung,* Hildesheim, Vol. 50, June 19, 1936, pages 1480-1482. Of numerous metals and alloys studied, V_2A-steel, Al, and Cr-plated or tinned Cu strips were corroded least when exposed in heated or soured cream. Metals corroded most included Ni, Fe, brass, plain Cu, and Al-Mg alloys. The metals corroded least had least effect upon the flavor of butter. Cr-plated Cu and tinned Cu were corroded less than other metals by cream, when exposed in combination with V_2A-steel, Al, and Cu. No flavor defects were produced in butterfat by the use of tinned or enameled containers, or by V_2A-steel containers.
GPS (13)

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The Thermal Reduction of Beryllium.
Investigation on the Dressing of Raw Beryl and on the Production of Beryllium Salts Suitable for Electrolysis.
Electrolytic Production of Beryllium.
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The Structure of Beryllium-Copper Alloys.
Physical Properties and Age Hardening of Beryllium Copper Alloys.
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Existence of an Oxide-film on Gold (Über die Existenz einer Oxydschicht auf Gold) W. J. Müller & E. Löw. *Berichte der deutschen Chemischen Gesellschaft*, Vol. 68, May 8, 1935, pages 989-991. The development of an oxide film on Au was investigated by treating the metal anodically in 5 *N* HCl and examining the surface with reflection-polarizing microscope. Passivation phenomena and photomicrographs demonstrate the existence of the film. FPP (13)

Boiler Protection against Corrosion (La Protection des Chaudières contre les Corrosions) Hans Richter. *Revue Universelle des Mines*, Vol. 12, Apr. 1936, pages 166-168. It is maintained that scale and slime are the worst foes of a boiler and often the cause of corrosion; for that reason removal of the slime is important and should be done regularly and, if possible, continually. Several methods to accomplish this by mechanical means are described. Ha (13)

New Laboratory Data Relative to Embrittlement in Steam Boilers. F. G. Straub & T. A. Bradbury. *Transactions American Society Mechanical Engineers*, Vol. 58, July 1936, pages 389-390. A new series of tests showed that purified $NaOH$ will not produce cracking of steel test specimens in short-time tests, whereas technical $NaOH$ made by the lime-soda process will produce cracking, and that cracking is due entirely to the impurities. When silica is present in sufficient amounts along with pure caustic, cracking will take place. The results seem to indicate that one or more catalysts must be present in the NoOH solution in order to cause cracking within a reasonable period of time. Ha (13)

Corrosion of Milk Tins in Ocean Transit. W. E. Seyer & R. J. Donald. *Canadian Chemistry & Metallurgy*, Vol. 20, July 1936, pages 227-228. Experimental data indicate that there are 2 underlying causes operating to bring about the rusting of the tins: i.e. the change in temperature of the humid air which produces sweating and the amount of salt contained in the sweat beads. To avoid the formation of rust it is necessary to prevent moisture from condensing on the tins, due to rapid temperature changes of humid air and to keep the salt content in the air as low as possible. The efficiency of certain carton containers sealed by various means is indicated. The more waterproof the container the more efficient the corrosion resistance. WHB (13)

Dissolved Oxygen and Embrittlement. W. C. Schroeder & O. C. Ralston. *Power*, Vol. 80, March 1936, page 145. Historical statement in regard to discovery of effect of SiO_2 in caustic embrittlement. AHE (13)

Electro-deposited Nickel. *Journal of Commerce, Shipbuilding & Engineeering Edition*, April 16, 1936, page 11. Applications of Ni deposition in marine engine maintenance for the repair of turbine shafts and turbine reduction gear shafts, where wheels have become loose due to wear; for the repair of turbine shafts and turbine blades, which have corroded and have been built up with deposited Ni or Cr; and for the repair of expansion sleeves, gudgeon pins, propellers, and piston rods. JWD (13)

Accelerated Tests Aid in Selection and Comparison of Metal Finishes. *Steel*, Vol. 98, Apr. 6, 1936, pages 42-43. Electrogalvanized apparatus was found to discolor rapidly in the field and it was decided to replace the Zn finish with an Al enamel. Test panels, made up of the Zn finish and 4 different systems of Al finish, were subjected to roof exposure, weatherometer, industrial atmosphere, aerated H_2O, and high-temperature high-humidity tests. Results showed that most of the Al finishes would give ample protection from corrosion and at the same time resist discoloration far longer than an electrogalvanized surface. It is also easy to touch up in the field. Although not rated the best finish of those tested, it was decided to use 1 coat baked Al over phosphate processed steel, as it was cheaper to apply than Zn and withstood the tests even better than the Zn. MS (13)

The Corrosion of Various Constructional Steels. J. Brillie, A. Leroy & A. Roux. *Iron & Coal Trades Review*, Vol. 132, June 19, 1936, pages 1109-1110. A report of researches on welding rods and electrodes for corrosion-resisting joints to the 12th International Congress of Acetylene, Oxy-acetylene Welding and Allied Industries described experiments from which it can be concluded that the metal deposited in a weld should be perfectly sound and free from air bubbles or inclusions of slag and oxides. The chemical resistance of the weld can be further improved by certain additions, such as Cr and Cu, Mn and Si, or Ni. Whereas additions of Cr and Cu are the most effective against acid attack, Ni produces the best chemical resistance against saline corrosion (sea water). Both parent material and weld metals should contain the least possible amounts of P and S impurities. Ha (13)

Failure of Metals due to Cavitation under Experimental Conditions. H. N. Boetcher. *Transactions American Society Mechanical Engineers*, Vol. 58, July 1936, pages 355-360. Recent experiments confirmed the mechanical character of cavitation in metals. Hardness tests showed that with many metals appreciable hardening of the surface is caused by cavitation and in Cu alloys and austenitic steels by strain lines. As only a small area is affected in this kind of failure, the name of "cavitation fatigue" is suggested. In order for a metal to have high resistance against cavitation fatigue it should have high corrosive resistance in the water in which it is used, and possess physical and metallurgical properties which result in high fatigue resistance, i.e. a high initial hardness with satisfactory toughness or susceptibility to considerable strain hardening The results are illustrated by many micrographs of cavitation failures. Ha (13)

Air Speed and the Scaling of Iron. W. Baukloh & O. Reif. *Metal Treatment*, Vol. 2, Spring 1936, pages 32-33. Abridged translation from *Metallwirtschaft*. See "Effect of Air Velocity on the Scaling of Iron," *Metals & Alloys*, Vol. 7, July 1936, page MA 372R/3. JCC (13)

Sweating of Sheets in Transit and Storage. G. C. Bartells. *Journal American Zinc Institute*, Vol. 17, 1936, pages 98-105. Galvanized sheets must not be stored in horizontal piles as temperatures changes cause condensation of moisture between the sheets. Chemical action then causes a white carbonate deposit on the surface of the Zn, which very quickly destroys the protective coating. Many cases have been found where sheets, after faulty storing in the warehouse, have shown disastrous effect of rusting only a few weeks after being placed on roofs or similar places where they are exposed to the elements. BHS (13)

Progress of Corrosion as Demonstrated by Contact Photographs (Ueber den Verlauf der Korrosion an Hand von Kontaktphotographieen) N. Goldowski. *Korrosion & Metallschutz,* Vol. 12, May-June 1936, pages 108-118. 2 types of corrosion can be distinguished: (1) corrosion characterized by the increase of points of attack according to an exponential function, and (2) corrosion by which the points of attack increase in surface. The methods of investigation are described for light metals and Fe metals, and the preparation of the surface of the sample by etching with a 3% NaCl solution with 0.3% $MgCl_2$ explained; the small holes developed in the corrosion test are photographed on photographic paper in contact with the sample. A theory is developed to calculate the progress of corrosion. 5 references. Ha (13)

New Materials Prolong Life of Equipment. James A. Lee. *Chemical & Metallurgical Engineering,* Vol. 43, July 1936, pages 359-363. Based on a paper given before the Chemical Engineering Congress of the World Power Conference, London, England, June 23, 1936. Developments in stainless steels, Cu-Ni alloys, Cu alloys, Pb, Al, and precious-clad metals are mentioned. 12 references. PRK (13)

The Atmospheric Corrosion and Tarnishing of Tin. L. Kenworthy. *Metal Industry,* London, Vol. 47, Dec. 6, 1935, pages 555-560; Dec. 13, 1935, pages 583-584. Report of an investigation conducted for the British Non-ferrous Metals Research Association, supported by the Tin Research & Industrial Application Committee. Reprinted from *Transactions of the Faraday Society.* See *Metals & Alloys,* Vol. 7, July 1936, page MA 372R/4. HBG (13)

Soil-Corrosion Studies, 1934. Rates of Loss of Weight and Pitting of Ferrous Specimens. K. H. Logan. *Bureau of Standards Journal of Research,* Vol. 16, May 1936, pages 431-466. The soil-corrosion investigation which was started in 1922 was originally planned to cover 12 years, plus the time required to write the final report. In 1934 the last of the original specimens were removed from 23 soils, but additions to the original test have so altered the plans that there now remain in the ground 7,500 specimens buried by the National Bureau of Standards and approximately 2,000 specimens of protective coatings prepared by research associates. In general, the results of the examination of the specimens removed in 1934 confirm earlier conclusions. The additional data permit the calculation of the standard errors for certain classes of data. The average maximum penetrations for the wrought-Fe, Bessemer, and open-hearth specimens do not differ by more than a few per cent. The specimens of open-hearth Fe and of open-hearth steel containing 0.2% of Cu appear to pit slightly more deeply than the other wrought specimens. In some soils cast Fe corrodes somewhat more rapidly than steel. Soils differ so greatly in corrosiveness that the average rates of corrosion or the average life of a pipe have little practical value. The addition of Cr to steel reduces the loss of weight by corrosion and the number of pits, but even a large percentage of Cr will not prevent serious pitting. This is especially true with respect to soils containing chlorides. The addition of Ni, with or without Cr, tends to reduce the depth of the pits. Certain materials seem to be especially suited or unsuited to certain types of soils. WAT (13)

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14. APPLICATION OF METALS AND ALLOYS

Improved All-Electric Typewriter Is Designed for Quietness and Speed. *Steel,* Vol. 98, May 4, 1936, pages 62, 65. Most of the approximately 600 parts of the machine are of steel, accounting for 57% of total weight. Al alloy die castings, Mg alloy, cast Fe, and brass tubing also are used. MS (14)

Bulk Sugar Kept Uncontaminated in Stainless Steel Freight Car. *Steel,* Vol. 98, Apr. 27, 1936, page 56. Bottom of car is composed of 4 hoppers fabricated of stainless steel, interior surface of which is polished to mirror-like smoothness. Lining of vertical sides and roof is of a Zn alloy. MS (14)

Structural Steel Frame, Zinc Exterior Panels Used in New Home Design. *Steel,* Vol. 98, Apr. 13, 1936, page 17. Describes method of Walter W. Ahlschlager, adopted by Estate Homes Inc., Chicago. Continuous length plates of pure Zn, without horizontal joints and with concealed vertical joints, are used for exterior walls. These plates are attached by a patented method to the framing. All framing members are structural steel similar to skyscraper construction and are shop fabricated from standard shapes. MS (14)

Prefabricated Building Units of Steel for Residence Construction. E. C. Kreutzberg. *Steel,* Vol. 98, Apr. 6, 1936, pages 36-38. Describes system of construction developed by the Reynolds Corp., New York, which permits complete freedom in executing building plans. Floor joists, studs, and other framing members are made of galvanized steel sheets rolled to the desired form and filled with nailing concrete. Plaster base fabric or lath is built up of V-shaped steel ribs, spaced 4" apart horizontally, and electrically welded to vertical cross wires which are woven through waterproof paper. Al foil is used for insulation. Floor slabs are formed by casting nailing concrete on a fabric backing heavily reinforced by steel. Cu is used for roofing. MS (14)

The Modern Tin Box. H. K. S. Lindsay. *Tin,* May 1936, pages 1-4. New applications of tin plate containers in Great Britain are discussed. These include cans for beer, oil, and cheese previously introduced in the U.S.A., new types of tooth powder dispensers and containers for vacuum packing of manufactured products such as medicated tablets, typewriter ribbons and tobacco as well as foods. BWG (14)

Use of Metals in Modern Engineering: Ferrous Metals. Light Metals. Lead (L'Emploi des Métaux dans la Construction Moderne. Les Métaux Ferreux. Les Métaux Légers. Le plomb) Michel Nation. *La Technique Moderne,* Vol. 28, Apr. 15, 1936, pages 266-270. Reviews applications of pure Fe, stainless steels, pure Al, duralumin, studal, almasilium. A special section is devoted to applications of light alloys in architecture. Uses of Pb in radiography are briefly described. FR (14)

Influence of Metals on Milk (Der Einfluss von Metallen auf die Milch) W. Ritter. *Schweizerische Milchzeitung,* Vol. 62, July 24, 1936, pages 331-332; July 28, 1936, pages 337-338. The presence of traces of Cu or its alloys was found to be detrimental to the flavor of milk, and caused the development of tallowiness and other catalytic oxidation flavors. Fe, Ni and Zn were less harmful. Al and its alloys, and different types of stainless steel were without effect. The latter metals are most desirable for storing, conveying and pasteurizing milk and milk products. GPS (14)

Tantalum Carbide—Its Relation to Other Hard Refractory Compounds. Philip M. McKenna. *Industrial & Engineering Chemistry,* Vol. 28, July 1936, pages 767-772. This article includes a compilation of physical properties of the compounds of the metals, Ti, V, Cr, Zr, Cb, Mo, Hf, Ta, and W. The melting points of carbides of Cr, Mo, and W are lower than those of either C or the metal; carbides of Ta, Cb, V, Hf, Zr, and Ti have higher m.p. than the respective metals. Uses of hard carbides of W and Ta as constituents of tool materials are discussed. TaC compositions are used to tip lathe and boring tools, and can cut stainless steels, stellite, Duralloy, Silcrome, Illium, and Hadfield's 12% Mn-steel. TaC and TaB_2 may be boiled with HNO_3 or with HCl or mixtures of the two without effect. A mixture of HF and HNO_3 alone will attack them. The 80% TaC compositions have a strength of 275,000 lbs./in.$_2$ on cross rupture tests. MEH (14)

The Problem of High Grade Materials and Machine Tool Design in Germany. Walter Storck. *Machinery,* London, Vol. 48, Apr. 9, 1936, pages 37-40. Reduction in consumption of Ni, Cr, Cu, Sn as raw materials imported into Germany is present economic aim. No substitutes have so far been found for machine tool members which take heavy or impact loads. The program calls for the use of alloys for surfaces that take the wear, corrosion or members that take the impact, and back this minimum section with cheaper plain cast steel or plain C steel. Mo cast Fe is sometimes used for bed castings but machinability is poor as compared with Ni cast Fe. Spindles of mild steel are built up with shrink on bushings of Ni steel. The trend is toward roller or taper bearings which allow use of mild steel spindles and shafts, the rollers of the bearings representing a minimum use of the alloys. Gears are built up by use of case hardened rim. Economics of the situation are such that production costs are often increased by the necessity of reducing alloy use. Substitutes for high grade bronzes are sought among Zn-Cu-Al and Cu-Pb alloys. The 85 Zn, 10 Cu, 5 Al, U. S. A. bearing metal has found approval in Germany as a substitute for the bronzes. Cast Fe was substituted for bronze in a clutch fork and synthetic molded material riveted on with Cu to prevent seizure. The molded materials are substituted for bronze where there is no swelling in the presence of oil. WB (14)

Effect of Modern Materials on Fine-Mechanical Constructions (Beeinflussung der Konstruktionen in der Feinwerktechnik durch neuzeitliche Werkstofffragen) W. Skawran. *Feinmechanik & Präzision,* Vol. 44, May 1936, pages 69-74. The influence which improved mechanical properties of metals and newly developed alloys have had on technical capacity, accuracy, economy and competitiveness of fine instruments are reviewed and illustrated by many examples. Ha (14)

14a. Non-Ferrous

G. L. CRAIG, SECTION EDITOR

The Setting of Amalgams. MARIE L. V. GAYLER. *Dental Cosmos*, Vol. 77, Nov. 1935, page 1140. Abstract from *British Dental Journal*, London, Vol. 59, Sept. 1, 1935, pages 245-251. The composition of the amalgam was found to vary with that of the alloy; a range of 25-27% Sn was selected for the alloy. Amalgams made from these alloys contained 13-16% Sn and 40-47% Hg. The amount of Hg used in mixing had little effect on the amalgam composition, if the excess was expressed immediately after mixing, and small variations in Hg content could not be associated with variations in dimensional changes of the amalgams. The amount of Sn removed by expressing the Hg was less than 2% of the original amount in these alloys but was greater with higher Sn contents. OEH (14a)

Aluminum Bells. HARRY N. HOLMES. *Nature*, Vol. 137, May 2, 1936, page 745. Brief note on use of Al for casting bells. CSB (14a)

Sleeve Bearings in High-speed Combustion Engines (Beiträge zur Gleitlagerfrage in schnelllaufenden Verbrennungsmaschinen) H. MANN. *Automobiltechnische Zeitschrift*, Vol. 39, June 10, 1936, pages 290-292. Bearing materials and their working are discussed. Two principal groups are distinguished: (1) Soft materials with Brinell hardnesses below 45 kg./mm.^{2}; to this group belong bearing metals on a basis of Sn, Pb, Cd and Pb-Cu alloys with or without small additions of hardening elements. (2) Hard bearing materials with Brinell hardnesses above 45 kg./mm.^{2} which include the various bronzes, light metals and gray Fe with hardnesses up to 200. Their particular properties under different conditions and machining methods are described. Ha (14a)

Telephone Lines of Aldrey Wire (Fernweldeleitungen aus Aldrey-Draht) M. PREISWERK & W. MÜLLER. *Aluminium*, Vol. 18, May 1936, pages 184-191. Telephone lines of Cu, bronze and galvanized Fe have (in Germany) been replaced by lines of Aldrey which, with a specific weight of 2.7 has mechanical advantages and does not require imported raw materials. Physical properties are compared with other materials and methods described for joining mechanically since soldering is not recommended. Ha (14a)

Aluminum Industry Makes Rapid Strides During Fifty Years Since Hall's Discovery. *Amercian Paint Journal*, Vol. 20, July 13, 1936, pages 16, 18, 21. An historical sketch dealing principally with the development of Al bronze powder and the advantages of Al paints. WHB (14a)

Aluminum in the Building Industry (Aluminium im Bauwesen) A. BRINCK. *Aluminium*, Vol. 18, June 1936, pages 237-241. Examples of use of Al for exterior and interior purposes in buildings are described. Ha (14a)

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Aluminum in the Norwegian Transportation Industry (Aluminium im norwegischen Verkehrswesen) A. BRINCK. *Aluminium*, Vol. 18, June 1936, pages 242-249. Railroad cars, including those for high-speed service, are described. Ha (14a)

Strontium in Industry. E. G. ENCK & GORDON H. CHAMBERS. *Chemical Industries*, Vol. 38, June 1936, pages 589-592. A survey of production and uses. Refers briefly to the use of Sr oxide in eliminating S and P from steel baths. RAW (14a)

Antimony as a Raw Material for the Chemical Industry. CHARLES HARDY. *Chemical Industries* Vol. 38, Apr. 1936, pages 363-365. A survey of production, markets and uses of Sb. RAW (14a)

Tube-wires of Aluminum-plated Iron Sheet (Rohrdrähte aus aluminiumplattiertem Eisenblech) P. JORDAN. *Aluminium*, Vol. 18, June 1936, page 262. Tubes of aluminated Fe are used as reinforcing material in walls of gypsum, or similar construction. Manufacture and types of wires are described. Ha (14a)

Aluminum as Cylinder Material for Internal Combustion Motors (Aluminium als Zylinderbaustoff für Verbrennungsmotoren) B. VON LENGERKE. *Automobiltechnische Zeitschrift*, Vol. 39, July 10, 1936, page 339. An Al-Cu-Si alloy (Y alloy), centrifugally cast, Brinell hardness 490, has been used for piston rings with very good success. Details of construction are described. Ha (14a)

Aluminum in the Rotors of Three-phase Motors (Aluminium im Läuferbau von Drehstrommotoren). MÜLLNER. *Aluminium*, Vol. 18, July 1936, pages 305-306. Cast- and die-cast parts are described. Ha (14a)

Aluminum in the Norwegian Fish Canning Industry (Die Einführung des Aluminiums in der norwegischen Fischkonservenindustrie) NICKELSEN. *Aluminium*, Vol. 18, June 1936, pages 234-237. Equipment and methods of making Al containers are described. Ha (14a)

Catalytic Properties of Rhenium (Über die Katalytischen Eigenschaften des Rheniums) M. S. PLATONOW, S. B. ANISSIMOW & W. M. KRASCHENINNIKOWA. *Berichte der deutschen Chemischen Gesellschaft*, Vol. 68, May 8, 1935, pages 761-765. Metallic Re is a relatively poor catalyzer for catalytic hydrogenation reactions, but most efficiently catalyzes the dehydration of ethyl alcohol. Catalytic oxidation reactions at high temperatures in the presence of Re are hampered by the formation of volatile Re oxide. FPP (14a)

Barium as a Chemical Raw Material. JAMES J. RILEY. *Chemical Industries*, Vol. 39, July 1936, pages 13-38. A survey of production and uses. RAW (14a)

Light Metal Wheels for Road Vehicles (Leichtmetall-Räder für Strassen-Fahrzeuge) M. KOENIG. *Aluminium*, Vol. 18, Mar. 1936, pages 81-87. The importance of reduction in the unsprung weight in vehicles is commented on and the advantages to be derived by using wheels and wheel rims of light metal illustrated by examples. An Al alloy of 43 kg./mm.^{2} tensile strength with an elastic limit of 33 kg./mm.^{2}, an elongation of 14%, and a Brinell hardness of 123 kg./mm.^{2} was used. Ha(14a)

14b. Ferrous

M. GENSAMER, SECTION EDITOR

Cast Iron for the Manufacture of Glass Bottle Moulds. N. L. EVANS, W. GOACHER & J. E. HURST. *Journal Society of Glass Technology*, Vol. 20, Feb. 1936, pages 45-53; discussion, Apr. 1936, pages 63-71; abstract, *Foundry Trade Journal*, Vol. 54, Feb. 27, 1936, page 171. Alloy Fe for bottle molds could probably be produced that would be better than plain Fe, but for cost reasons plain irons are used. The glass temperatures within the mold vary from 700° to 1000° C., the outside temperature of the mold from 300° to 500° C. Recommended composition of Fe is total C not over 3.10%; Mn 0.80-1.50%; S 0.07% Max., P 0.45% Max.; with Si ranging from 2.50% for a casting ½" thick down to 1.30% for one 2½" thick. Brinell hardness is 215-235. High Mn is used to obtain a fine-grained structure, S is kept low by soda-ash treatment, P is held to 0.45% because of alleged deleterious effect (not explained) on high temperature properties. Failure of molds is related to propensity toward growth of the Fe. The Fe should be close so as to take a good polish, hence the total C should be kept down. In discussion it was pointed out that the interior surface should be made dense by chilling and that by varying the chill according to the wall thickness of the mold, metal of one Si content could be used for a variety of thicknesses. Cast Fe was approved for molds meant for short runs, but austenitic heat resistant alloys were preferred by several for long runs. FeNi + Cr + W, and alloys with 20 Cr, 25 Ni or 11 Cr, 58 Ni were mentioned. Authors' reply maintains that it is better to adjust Si than to chill. HWG + AIK (14b)

Cast Camshafts and Crankshafts (Gegossene Nocken- und Kurbelwellen) H. CORNELIUS & F. BOLLENRATH. *Giesserei*, Vol. 23, May 8, 1936, pages 229-236. Present trend in using cast instead of forged shafts, reasons for using them and advantages, experiences in automobile manufacture and in pumps, are discussed at length. 39 references. Ha (14b)

Wood Joins Steel in New Sheet Applications. ROGERS A. FISKE. *Iron Age*, Vol. 138, July 2, 1936, pages 30-33. Describes products of Haskelite Mfg. Co., Chicago, known as "Steelwood" and "Plymetl." The former has facings of thin wood veneer glued to sheet steel; the latter has facings of thin sheet steel glued to plywood. Applications extend all the way from novelties to architectural treatment. Steelwood is adapted to forming operations which do not involve much stretching along grain of the face veneer. Plymetl is much stronger and stiffer than its component parts. Galvannealed sheet steel of special grade is material most commonly used. VSP (14b)

The Development of Proferall Cast Camshafts. D. J. VAIL. *S. A. E. Journal,* Vol. 39, July 1936, pages 288-292. Details of process, properties of processed-ferrous-alloyed-iron (Proferall) camshaft for aero engines. Analysis, total C 3.10-3.40, Si 2.10-2.40, S .10 max., P .20 max., Mn .50-.75, Cr .75-1.00, Ni .20-.40, Mo .40-.60. Scrap Fe and pig is melted in cupola, Cr briquettes added and melt transferred to electric furnace for final alloy additions and refining. Brinell as cast 262-293. Results of wear tests on 5 camshaft gears are shown in a table along with chemical analysis and hardness, which together determine wear resistance rather than hardness alone. Both journal and bearing wear is less than for steel shafts. Thermal expansion is less for cast material. Production cost is lower. Discussion of machining follows. Details of finishing the cast shaft are given as practiced for the Hudson Motor Car. Advantages of modern forging methods are also reviewed in discussion. WB (14b)

Rock Drill Steel. C. H. VIVIAN. *Compressed Air Magazine,* Vol. 41, Apr. 1936, pages 4991-4997. The importance and extent of application of steel drills are discussed and methods of production and inspection described. P and S are the most undesirable impurities. Swedish production is in acid open hearth in small lots. Before rolling, billets are pickled, chipped, ground and pierced with an austenitic steel core, which is later extracted by breaking the ends of the external section, and stretching the core, after which it is cut and withdrawn by hand. The hole must be round, well centered and of uniform diameter throughout its length. Most rock-drill steel failures are fatigue failures, originating in surface defects. Inner surface of modern metal-core processed drill is far superior to that produced by the old sand-core or the mandrel-rolling methods. FPP (14b)

Corrosion Resisting Steels for High Strength. ERNEST E. THUM. *Metal Progress,* Vol. 29, June 1936, pages 49-55, 104; (abstract) *Steel,* Vol. 98, Mar. 9, 1936, pages 45, 75. Heat treatment of stainless steels results in very high properties indicating wide variety of engineering applications. 12% Cr with less than 0.09% C is capable of very high strengths; 1200° F. draw after 1750° F. quench results in over 100,000 lbs./in.^{2} tensile strength and 80 ft. lb. Izod. These excellent properties are taken advantage of in the application to turbine blading. Graphs are given showing the heat treated properties of various steels of the 0.30-0.40% C cutlery grade. Applications are discussed. WLC + MS (14b)

Steel Progress and the Steam Engineer. L. SANDERSON. *Steam Engineer,* Vol. 5, Mar. 1936, pages 242-243. The metallurgical developments of 1935 in heat-resisting steel, hard-facing processes, pure metal spraying, Re-coating, corrosion-resisting steels, steel for pressure vessels and alloy steel rivets are reviewed. AHE (14b)

Foresees Wide Application for New Low-Alloy High-Tensile Steels. *Steel,* Vol. 98, May 11, 1936, pages 76-78. These steels will find increasing use in the automotive field; structures such as elevated H_2O tanks, stand-pipes, transmission towers, elevators, stairways, and floors; overhead traveling cranes; clam-shell and other types of buckets; mine-cars and cages; gas-producers; conveyors and driving-chains; and the power-plant field. MS (14b)

Valve with Stainless Steel Disks is Designed for Hot Gas Service. *Steel,* Vol. 98, Apr. 6, 1936, page 58. Valve for blast-furnace and coke-oven gases has valve-seats and valve itself inclosed completely in a single steel casting. Unit is built with 2 stainless steel disks which are expanded against the seats by high pressure, mechanically applied. MS (14b)

Manufacture of Cast Iron Automobile Parts (La Fabrication des Pieces d'Automobiles coulées en fonte) BROCHETON. *Revue de Fonderie Moderne,* Vol. 30, Apr. 10, 1936, pages 109-115. Different kinds of molding, preparation of molding sands, composition of cast Fe used for different engine parts and correct casting temperatures are discussed. Ha (14b)

Wire Rope for Mining. G. H. CUTTER. *Mining & Metallurgy,* Vol. 17, June 1936, pages 283-285. Describes the manufacture, use and maintenance of wire rope in mining. Highly important requirements are best met by acid open-hearth steel, according to most manufacturers. Ropes are made in several grades such as: Fe, cast steel, extra strong cast steel, plow steel and improved plow steel. Ropes with fewest number of wires are best suited for resisting abrasion and corrosion. Gives various uses of the different grades of wire. VSP (14b)

Steel Tubing. *Times [London] Trade & Engineering,* Vol. 38, Dec. 1935, page XI. Outlines methods of manufacture and some uses. MS (14b)

Stainless Steels and Irons. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XI. Deals with their development and applications. MS (14b)

Modern Boiler Manufacture. *Electrical Review,* Vol. 118, June 5, 1936, pages 807-809. Describes Renfrew, Scotland, works of Babcock & Wilcox, Ltd. Outlines equipment and operations, such as forging, welding, annealing, X-ray examination and founding. MS (14b)

American Tentative Standard Wrought-iron and Wrought-steel Pipe. *American Standards Association,* A. S. A. No.: B 36.10-1935, 12 pages. AHE (14b)

American Standard Cast Iron Soil Pipe and Fittings. One of a Series of Standards for Plumbing Equipment. *American Standards Association,* A. S. A. No.: A 40.1-1935, 44 pages. AHE (14b)

Standard Specifications for Billet-steel Concrete Reinforcement Bars. *American Society Testing Materials,* A. S. T. M. Designation: A 15-35; *American Standards Association,* A. S. A. No.: A 50.1-1936, 5 pages. AHE (14b)

Standard Specifications for Rail-steel Concrete Reinforcement Bars. *American Society Testing Materials,* A. S. T. M. Designation: A 16-35; *American Standards Association,* A. S. A. No.: A 50.2-1936, 3 pages. AHE (14b)

Standard Specifications for Cold-drawn Steel Wire for Concrete Reinforcement. *American Society Testing Materials,* A. S. T. M. Designation: A 82-34; *American Association State Highway Officials Standard,* A. A. S. H. O. No.: M-32; *American Standards Association,* A. S. A. No.: A 50.3-1936, 3 pages. AHE (14b)

Application of Alloy Steels. H. W. MCQUAID. *Iron Age,* Vol. 136, Dec. 26, 1935, pages 18-22. From a paper read before the American Institute, Dec. 13, 1935. See *Metals & Alloys,* Vol. 7, July 1936, page MA 378L/4. VSP (14b)

Use of Alloy Cast Iron Grows. GARNET P. PHILLIPS. *Automotive Industries,* Vol. 74, May 23, 1936, pages 732-740. Alloys most commonly used in the automotive industry are Ni, Cr, Mo, Cu, and Ti. The alloy cast irons are better adapted to heat treatment than unalloyed irons, and producers are constantly experimenting to find more serviceable metals. A number of metal compositions are given for various castings, as cylinder blocks, crank cases, valve seat inserts, valve guides, cylinder liners and sleeves, clutch pressure plates, exhaust manifolds, brake drums, iron dies, camshafts and crankshafts. BWG (14b)

Spirals and Other Fabricated Steel Units Permit Delivery of Clean Coal. L. O. RICHARDS. *Steel,* Vol. 98, Apr. 13, 1936, pages 42, 44. Spirals of riveted steel plate construction lower coal into distributor's bin at a uniform speed to prevent breakage. They are usually constructed of standard C plate but Cu bearing steel is sometimes used. Another product is a bin gate which gives coal a final screening as it is loaded into trucks. Gates and screens are of welded steel plate construction. Third unit is a self-supporting boom to facilitate truck loading. It is built up of standard steel shapes and plates welded together, except the drag trough which is bolted for replacement. MS (14b)

New Spring Formulas and New Materials for Precision Spring Scales. M. F. SAYRE & A. V. DE FOREST. *Transactions American Society Mechanical Engineers,* Vol. 58, July 1936, pages 379-387. Developments in springs for precision measuring instruments is reviewed and a new type of helical spring of a modified elinvar metal, containing 36% Ni, 8 or more % Cr, 4% of other elements such as Mn, Si, Mo, Cu and V, remainder Fe is described. Errors in the instrument could hereby be kept down to within 0.05%. High-degree cold-drawing combined with a special heat-treating process increased working stresses to 60,000 lbs./in.^{2} in shear while the error due to creep under working loads was less than 0.02%. Performance of the instrument is described in detail, the theory is given in an appendix. Ha (14b)

Materials for Exhaust Valves (Werkstoffe für Auslassventile) E. SCHMIDT & H. MANN. *Automobiltechnische Zeitschrift,* Vol. 39, June 25, 1936, pages 303-312. The extreme stresses which exhaust valves must withstand, especially in airplane motors, are explained and the properties of materials to satisfy these claims are discussed. Steels available at present for this purpose are: (1) steels which have very little high temperature strength, a transformation point within the service temperature and low resistance against scaling and corroding; these must not be used. (2) Steels which have no transformation point within the operating temperature and a good corrosion and scaling resistance, but the high temperature strength of which deteriorates quickly above 700° C., such as the martensitic Cr-Si steels; they can well be used if the temperature does not exceed 650°-700° C. (3) Steels like the austenitic Cr-Ni-W steels, which have no transformation point and high strength at elevated temperatures; they can be used for temperatures up to 800° C. and more if cooled. Their comparatively low hardness should be improved by nitriding or pressing of the surface. Tables showing composition of materials and properties are given. 30 references. Ha (14b)

Metal Lining Improves Concrete Tanks. HUGH S. WEIGHTMAN. *Chemical & Metallurgical Engineering,* Vol. 43, July 1936, pages 373-374. Methods of building large concrete tanks and lining them are given. PRK (14b)

Standard Specifications for Structural Steel. A. F. WEBBER. *Iron & Steel Industry,* Vol. 9, Mar. 1936, pages 210-213. Changes in a revision of British Standard Specification, No. 15, for Structural Steel for Bridges, etc., and General Building Construction are pointed out and discussed. CMS (14b)

Cylinder Castings for 4-6-0 type Locomotives, L. M. S. R. *Railway Gazette,* Vol. 64, June 5, 1936, page 1081. Illustrated description is given of cylinder castings and piping for a 2-cylinder general utility engine. Each cylinder is cast separately with its steamchest above it, the piping with smokebox saddle and base for the blast pipe forming another integral casting, bolted by means of flanged connections to the cylinder branches. Recent modifications have stiffened exhaust passages between frames. FPP (14b)

Constructions with 18:8 Steels (Constructions en acier inoxydable 18-8) ENÉA BOSSI. *Métaux,* Vol. 10, Dec. 1935, pages 315-323. General discussion of uses of stainless steels in railroad, aviation, and marine fields. GTM (14b)

Tools for the Engineer. BERTRAM BALFOUR. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XV. Summarizes progress in design, quality and material for cutting-tools. MS (14b)

Stainless Steel as a Medium for Artists. OSCAR B. BACH. *Metal Progress,* Vol. 29, June 1936, pages 37-39. General. WLC (14b)

The Hubbing of Dies for Embossing Jewelry Parts. G. R. HOUGHTALING. *Metal Progress,* Vol. 30, July 1936, pages 46-48. Technique of this difficult work is described. Hub material used is C 0.65-0.75, Mn 0.50-0.60, Ni 1.50-1.75, Cr 1.50-2.00, Mo 0.25, V 0.25. Die material is C 0.60-0.70, Mn 0.60-0.70, Ni 1.25-1.75, Cr 0.65-0.85. WLC (14b)

European Status of the Stainless Steels. J. H. G. MONYPENNY. *Metal Progress,* Vol. 29, June 1936, pages 68-69. Martensitic stainless steels show no change except for the introduction of new 16-20% Cr, 1-3% Ni type which is more resistant to sea water and susceptible to treatment for high strengths. Ferritic types are low in impact and high temperature strengths. 16-18% Cr type has fair impact. This class of stainless is used mainly for its resistance to S gases. In the austenitic type, 18-8, Ti is used for freedom from weld decay. Si up to 6% is also effective in this respect and increases the resistance to oxidation and to many acids. It is used in aircraft and chemical applications. Chemical industries use much of the 4% Mo 18-8 which requires no treatment after welding and has increased acid resistance. This class as a whole is applicable to high temperature service. WLC (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

Use of Artificial Grinding Agents in the Tool Industry (Die Verwendung künstlicher Schleifkörper in der Werkzeugindustrie) Fritz & Kremer. *Oberflächentechnik,* Vol. 13, July 21, 1936, pages 159-164. Injury to health by dusts in grinding and polishing processes is discussed and statistics for compensation paid in German industries are given. Contrary to general views, wet grinding gives rise to the most serious injuries to the lungs. According to present experiences, grinding discs with mineral binders can compete very satisfactorily with natural sandstones. Oxidic Mg compounds as grinding material are conducive to reducing dust in grinding shops and lessen the danger of silicosis. Ha (15)

Standardization (La Normalisation) Girardeau. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 7, Jan.-Feb. 1936, pages 2035-2053. Lecture before the French Welders' Society. Aim of standardization is threefold: (1) simplification to reduce as far as possible number of parts having the same use, (2) unification to allow parts to be interchangeable, (3) specification to establish minimum figures for quality testing of parts. Standardization is not only applied to materials but also to classifications, use of marks, definitions, etc. Author reviews French organizations and summarizes what has been done in France and in the world as to standardization. FR (15)

Filtration of Air in Foundries (Die Filterung der Luft in Giessereien) O. T. Koritnig. *Giesserei,* Vol. 23, June 5, 1936, pages 295-298. The hygienic and economic harmfulness of the dust in foundries is pointed out and means for dust removal by filtering or electrical precipitation and their respective advantages discussed. Ha (15)

Ford Production Methods. Hartley W. Barclay. Harper & Brothers, New York, 1936. Cloth, 9 x 12 inches, 215 pages. Price $5.00.

The entire text of this volume appeared as the January 1936 issue of *Mill and Factory,* of which Mr. Barclay is editor. The portions of metallurgical interest have been abstracted in *Metals & Alloys,* Vol. 7, June 1936. The book is unique in several respects, but chiefly because it manages to avoid the taint of propaganda that often accompanies descriptions of operating methods and experience. This is possibly because Mr. Barclay has done his job with the utmost thoroughness, omitting abstract generalizations, and describing processes in every necessary detail. The volume includes several flow sheets and floor plans and hundreds of photographs and drawings of parts and equipment. In addition to the sections of direct metallurgical interest, previously abstracted, the book contains chapters on Methods, Safety, Air-Conditioning, Buildings, Materials Handling, Mechanical Power, Transmission, Power, Tools and Accessories, and Lighting and Electrical Apparatus, and is well indexed. The volume should have distinct reference value to the production metallurgist and to all operating executives.
Fred P. Peters (15)—B—

Selected Chemical Analytical Methods for Iron and Steel Industries (Ausgewählte chemische Untersuchungsmethoden für die Stahl- und Eisenindustrie) Otto Niezoldi. Julius Springer Verlag, Berlin, 1936. Paper, 5½ x 8¼ inches, 152 pages. Price 5.70 RM.

This book is divided into 3 parts. The first covers analytical methods for the elements usually determined in Fe and steel, and some less commonly determined including Mo, Cu, W, V, Co, As, Al, and N. Methods are also included for the common ferro alloys. The second part is devoted to common nonferrous metals and alloys, and the third to slags, ores, boiler scale, dolomite, magnesite, lime, coal, water, producer and water gas.

The book outlines routine and not umpire procedures. Usually a few notes are included with each outline. Directions are brief and to the point. The degree of accuracy of the various methods is not discussed. It is not a text book, but because of the large number of procedures of varying nature outlined some steel plant chemists may find it to be a valuable addition to their library.
J. D. Sullivan (15)—B—

The Norwegian Aluminum Industry (Die Aluminium Industrie Norwegens) A. Brinck. *Aluminium,* Vol. 18, June 1936, pages 231-233. Development and present conditions are described. Annual production of 37,000 tons is possible.

Barite in France (La Baryte en France) V. Charrin. *La Revue Industrielle,* Vol. 66, Mar. 1936, pages 110-112. Explains chief sources of Ba ores in France (yearly production, 50,000 tons). Geological structure of countries where barite is extracted is explained. FR (15a)

Market Studies Uncover New Steel Uses and More Steel Profits. John Allen Murphy. *Iron Age,* Vol. 137, May 28, 1936, pages 27-33. Discusses method of procedure in market research and results obtained. VSP (15a)

The European and World Zinc Situation in 1935. O. W. Roskill. *Journal American Zinc Institute,* Vol. 17, 1936, pages 111-119. A review of the important European Zn producers, with production data, operating figures, ore supply, and important developments at various plants. BHS (15a)

Progress in English Cast Iron Production (Fortschritte in der englischen Gusseisenerzeugung) J. G. Pearce. *Giesserei,* Vol. 23, May 22, 1936, pages 262-265. Development, methods of practical and theoretical research, organization and testing methods are reviewed, and the activity of the British Cast Iron Research Association is described. 14 references. Ha (15a)

The Nickel Industry in 1935. Robert C. Stanley. *Metal Industry,* London, Vol. 48, Jan. 10, 1936, pages 32-35. An economic survey of the industry showed that in 1935 more Ni was consumed than in any previous year. While a portion was for munitions most of it went into diversified peacetime industrial work. This, in part, was attributed to the greatly increased investigative research and development work which has been carried on for a number of years by the producers. Numerous examples are cited in both ferrous and nonferrous fields where the addition of Ni or the development of new alloys have made possible new applications of materials. HBG (15a)

Zinc as a Chemical Raw Material. B. R. Silver. *Chemical Industries,* Vol. 38, Jan. 1936, pages 25-28; Feb. 1936, pages 141-144. Discussion of world production, specifications, sales and consumption, and uses. Summary of price fluctuations over several years. Functions of American Zinc Institute discussed. RAW (15a)

Great Lakes Levels Mean Dollars to Steel Industry. F. W. Trezise. *Steel,* Vol. 98, Apr. 27, 1936, page 36. Discusses economic value of maintenance of sufficiently high water levels, particularly in lakes Michigan and Huron, to make use of the maximum available draft of vessels. It has been calculated that a loss of 1 ft. of draft in an average year means a loss of $8,000,000 to lake shippers. MS (15a)

Metal Ore Deposits in Vosges (Les Gîtes Métallifères des Vosges). C. Thirion. *La Revue Industrielle,* Vol. 66, Apr. 1936, pages 141-151. General. FR (15a)

Working Methods of a Modern Research Laboratory in Developing Aluminum Alloys (Die Arbeitsweise eines modernen Forschungslaboratoriums bein der Entwicklung von Aluminiumlegierungen) A. v. Zeerleder. *Aluminium,* Vol. 18, July 1936, pages 297-298. Procedure in testing properties of new materials and releasing for commercial exploitation after they have been found satisfactory are described. Ha (15a)

■ 15a. Economic ■

Coal, Iron and Steel in Germany. *Iron & Coal Trades Review,* Vol. 133, July 24, 1936, pages 136-137. Statistics on production, exports and imports of ores, coke, scrap, and Fe and steel; development of syndicates and financial organizations are discussed. Ha (15a)

1935 Steel Ingot and Casting Output in Excellent Gain over Previous Year. *Steel,* Vol. 98, May 11, 1936, pages 40-41. Official figures of the American Iron and Steel Institute on production of steel ingots, castings, and rolled products. MS (15a)

The Copper Industry in 1935. Output and Production Costs. G. Abrahamson. *Metal Industry,* London, Vol. 48, Jan. 31, 1936, pages 155-156. In Mar. 1935 delegates of the great Cu-producing companies met in New York to agree upon a restriction of output. In spite of the fact that world consumption of Cu was continuing to increase, factors that counterbalanced the favorable effects of this increase were (1) American producers considered the European market a permanent outlet for their surplus stock, (2) new sources of production, with a low cost output, were now a factor demanding consideration, and (3) by-product Cu also became a serious factor. While all parties of the New York agreement adhered to the restrictions there was a slight increase in production in 1935 over 1934. Germany was about the only major country, outside of the U. S. A., in which Cu-consumption did not increase during the past year. This is attributed to the greatly increased quantities of Cu and brass scrap purchased by Germany. Costs of production of the various producers are discussed and it is shown that in the mines of South Africa, Cu can be produced at the lowest cost. However portions of the costs of production of some of the other companies are offset by revenue received from the sale of other metals. It is believed that possibilities of replacement of Cu by Al and other metals has been overestimated. HBG (15a)

■ 15b. Historical ■

A Survey of Engineering and Metallurgical Progress. G. E. Wolstenholme. *Proceedings Institution of Mechanical Engineers,* Vol. 131, Nov.-Dec. 1935, pages 525-629. Change and development of engineering methods in the last 40 years are reviewed. Ha (15b)

Early Chinese Metallurgy. E. A. Smith. *Metal Industry,* London, Vol. 48, Jan. 10, 1936, pages 27-31. An exhibition by the Royal Academy in London of work of Chinese craftsmen has raised the question of the production and working of metals in ancient China. A period of 35 centuries is covered by exhibits which begin with samples of the Bronze Age and continue as far as 1800 A.D. Until recent years little effort has been made to trace the history of metal working in China due to the opposition of both the government and the people in the country. This article is a brief summary of recent investigations made by A. S. Wheler and Robt. Slessor. It is their belief that in the outlying districts today the natives follow empirically methods of earlier days which have not been changed since 2850 B.C. All the base metals, as well as Au and Ag were produced in China before our civilization began by methods showing a sound knowledge of the principles of metallurgy. Although crude equipment was used and at a low efficiency, yet metals of high purity were obtained. Backed by recent discoveries of archaeologists, it is suggested that the art of metallurgy may have begun in Asia and possibly in China. The mineral resources are inexhaustible and practically untouched. The crude methods used in obtaining Sb, Cu and the early bronze, the "lost wax" process—believed to have been originated by the early Chinese, Au and Fe are outlined. The smelting of galena appeared to be solely to obtain the Ag present. The equipment and process used are briefly discussed. In a similar manner the methods used for obtaining Hg, Sn, Zn, and the smelting of complex ores are considered. The article is illustrated with drawings of the crude equipment used. 3 references. HBG (15b)

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METALLURGIST, immediately available. Technical graduate, studied under Dr. Albert Sauveur and Dr. V. N. Krivobok. 3 years of practical experience in research on failures, development and plant control of alloy and plain carbon steels. Also 3 years of experience in ore dressing and mining engineering. Single, 33 years of age, no preference to location. Address Box MA-15, METALS & ALLOYS, 330 W. 42nd St., New York.

METALLURGIST available. A young Dutch metallurgist, now employed in the laboratory of a machine and chain works in Holland, wants to get a chance in the U. S. A., with opportunities for increased responsibility and salary. Box MA-16, METALS & ALLOYS, 330 W. 42nd St., New York.

CURRENT NEWS ITEMS

A.F.A. Chooses Milwaukee for 1937 Convention and Exposition

Milwaukee, one of the foremost foundry centers in the United States, has been selected for the 41st annual convention and exposition of the American Foundrymen's Association, to be held during the week of May 3, 1937. The meetings and display of equipment and supplies will be staged in the Milwaukee Auditorium.

The board of directors, in selecting Milwaukee for the 1937 gathering of the foundry industry, gave recognition to the progressive Milwaukee Chapter. The interest and activity of the foundrymen of that section has placed Wisconsin in high rank in technical attendance and in handling the practical problems of foundry practice, apprentice training, cost, safety and hygiene. Outstanding plants, making all classes of castings, will be available for inspection.

Milwaukee is eminently suited for the activities planned. Hotel accommodations have been greatly expanded since the last previous A. F. A. convention held there in 1924. The auditorium, often cited as a model of such structures, and located within walking distance of the business and hotel section of the city, has full facilities for technical and committee meetings and for exhibits of equipment and supplies used in the foundry industry.

New Building for Battelle

The trustees of Battelle Memorial Institute, Columbus, Ohio, have announced the start of a building program to provide additional facilities for industrial research. Ground for a new building which will contain approximately 25,000 sq. ft. was broken on Oct. 5, and it is expected that it will be ready for occupancy shortly after the first of the year. The divisions of process metallurgy, ore dressing and coal processing will be housed in the new building which has been designed to accommodate the heavy equipment necessary for commercial scale foundry work and ore handling.

Nickel Company's Research Laboratory in England

Robert C. Stanley, president of The International Nickel Co. of Canada, Ltd., has announced the formal opening of the company's new research and development laboratory at Birmingham, England. Among those participating in the ceremony were the Lord Mayor of Birmingham and several officers and directors of the company, including Lord Weir, Lord Melchett, Sir Harry McGowan, Dr. John F. Thompson, executive vice-president, and D. Owen Evans, M.P., who is a vice-president of the parent company and delegate director of The Mond Nickel Co., Ltd., which forms its English division.

Additions to Battelle's Staff

D. A. Roberts, formerly with the W. E. Mowry Co. of St. Paul, and E. E. Slowter, formerly with the Pittsburgh Plate Glass Co., have accepted positions on the staff of Battelle Memorial Institute, Columbus, Ohio. Mr. Roberts will work on various phases of research in metallurgy and Mr. Slowter in chemical industry.

Metallurgical Service for South America

E. F. Feely, representative of The International Nickel Co. in South America, and J. S. Vanick, a member of the Development and Research Division, New York, are visiting several South American countries within the next few months in order to offer consultation service to industrial executives and engineers on problems involved in the production and application of nickel alloys. Both men are metallurgists and qualified by training and experience to provide valuable assistance in an advisory capacity.

Welding Authority Is Honored

Henry M. Hobart, for the past 25 yrs. a consulting engineer with the General Electric Co. at Schenectady, N. Y., was presented with the Samuel Wylie Miller Memorial Medal in recognition of his outstanding service in the advancement of welding research at the annual meeting of the American Welding Society, October 19, in Cleveland.

Mr. Hobart, an authority on arc welding, was a member of the welding committee formed by the United States Shipping Board at the time of the World War. He is a director of the American Welding Society, and chairman of the fundamental research committee of the Engineering Foundation Welding Research Board.

Chemical Industry Medal to Dr. Landis

The Chemical Industry Medal for 1936 was presented Nov. 6 to Dr. Walter S. Landis of the American Cyanamid Co. at a joint meeting of the American Section of the Society of Chemical Industry and the American Chemical Society, held at The Chemists' Club, New York. Dr. M. C. Whitaker first spoke on the accomplishments of the medalist and then the presentation of the medal was made by Dr. D. D. Jackson of Columbia University. In accepting the medal, Dr. Landis told about the developments in the fertilizer industry, the subject of his paper being "Concentrated Fertilizers."

Personals

Paul S. Lane, chief metallurgist of the Koppers Co., American Hammered Piston Ring Division, Baltimore, has assumed his new duties as metallurgical research engineer. A new physical testing laboratory and enlarged dynamometer room has recently been completed to permit of more extensive research into piston ring and engine problems. Mr. Lane is secretary-treasurer of the Baltimore Chapter, American Society for Metals, and a member of the American Foundrymen's Association and the Society of Automotive Engineers.

Eugene J. Ash, formerly of the Bureau of Standards, the Naval Gun Factory and the Watertown Arsenal, has assumed the position of teaching the metallurgy of cast metals in the department of metal processing in the college of engineering of the University of Michigan.

Lewis B. Lindemuth, New York, has just returned from England where he is engaged as consulting engineer for Richard Thomas & Co., Ltd., in connection with their expansion program. Mr. Lindemuth sails for Australia in November where he goes each year as consultant for the Broken Hill Proprietary Co., Ltd.

J. C. Chaston, abstractor for METALS AND ALLOYS, has been appointed senior lecturer in metallurgy at the Royal Technical College, Glasgow.

J. W. Weitzenkorn, former president of the Molybdenum Corp. of America, has become associated with the **Ohio Ferro-Alloys Corp.,** at Canton, Ohio, as director of research.

Election of **Frank Malcolm Farmer,** vice-president and chief engineer of the Electrical Testing Laboratories, New York, as chairman of the **Engineering Foundation,** research organization of the national engineering societies, is announced. Mr. Farmer, an authority on electrical measurements, electrical insulating materials, testing of engineering materials, and high voltage cables, succeeds H. P. Charlesworth, assistant chief engineer of the American Telephone & Telegraph Co.

A. E. Gibson, vice president, Wellman Engineering Co., Cleveland, has been elected president of the American Welding Society for 1936-1937.

MANUFACTURERS' LITERATURE

Potentiometer Control Pyrometer

The principles, operating details and methods of application of the Stabilog Potentiometer Control Pyrometer are described in Bulletin 194-1. Related equipment for automatic temperature control is also covered. The Foxboro Co., Foxboro, Mass. (1192)

Sand Control in the Foundry

A colorful pamphlet lists the major causes of casting defects and inferiorities and states that they may be avoided by the use of the proper sand control equipment. Illustrated. Harry W. Dietert Co., Detroit, Mich. (1193)

Stainless and Heat Resisting Steels

The application of stainless steels in the process industries is the subject of an attractive, illustrated, brochure. Physical and mechanical properties of the various grades of the corporation's stainless are included. United States Steel Corp. Subsidiaries, Pittsburgh, Pa. (1194)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-ray has now come to the fore as a tool of the testing laboratory. Kelley-Koett Mfg. Co., Inc., Covington, Ky. (1195)

Chapmanizing

A pamphlet devoted to Chapmanizing, which is a process of hardening low-carbon steel, compares it to nitriding and carburizing. The Chapman Valve Mfg. Co., Indian Orchard, Mass. (1196)

Spectrometric Equipment

Catalog D-221 is devoted to the above equipment. Basic theory and designs are described as well as the various types of instruments. Illustrated. Bausch & Lomb Optical Co., Rochester, N. Y. (1197)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (1198)

Salt Bath Furnace

The Ajax-Hultgren electrically heated salt bath was designed to meet the metallurgical requirements of liquid heat treating operations. Bulletin 103 lists some of the advantages of the furnace. Illustrated. Ajax Electric Co., Inc., Philadelphia, Pa. (1199)

Furnaces

Information concerning Hausfeld modern melting equipment for die casting is featured in an illustrated leaflet. These furnaces are made interchangeable for oil or gas fuel. Campbell-Hausfeld Co., Harrison, O. (1200)

Alloy Castings

Corrosion resistant and stainless steel castings are the subject of a new booklet. Chemical and metallurgical properties of these castings are included. Illustrated. Michiana Products Corp., Michigan City, Ind. (1201)

Modern Metal Treatment

A colorful pamphlet lists the R & H chemicals available for heat-treating, electroplating and for cleaning metals. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (1202)

Optical Pyrometer

The Burrell optical pyrometer, a direct reading instrument originally designed for use with the Barrett fusion furnace and equally useful for other work requiring an optical pyrometer with a temperature range from 1500 to 3000 deg. F., is described and illustrated in a leaflet published by the Burrell Technical Supply Co., Pittsburgh, Pa. (1203)

Hardening Control

Useful information regarding case hardening steel is contained in a booklet of the A. F. Holden Co., New Haven, Conn. (1204)

Zinc Alloy Die Castings

A technical booklet tells the story of the development of the "Zamak" alloys. Tables and illustrations. New Jersey Zinc Co., New York, N. Y. (1205)

Special Atmospheres in the Heat Treatment and Brazing of Metals

A reprint of the above article by C. L. West, Research Engineer, is offered by The Electric Furnace Co., Salem, O. (1206)

Enduro

Data on the welding of Enduro stainless steels are given in a colorful brochure. Electric arc, gas, spot and projection, seam, flash, atomic hydrogen welding and brazing and silver soldering are features of this discussion. Republic Steel Corp., Massillon, O. (1207)

Phosphor Bronze

A leaflet lists the sizes in which the company's twelve-inch stock bushing bars are now offered. The Phosphor-Bronze Smelting Co., Philadelphia, Pa. (1208)

Sixteen Sins of the Cleaning Room

Are listed in a circular for convenience in checking on cleaning rooms. Great Lakes Foundry Sand Co., Detroit, Mich. (1209)

Free Cutting Steel

An attractive booklet records fifteen years spent by the company's metallurgical department in research on the machinability of free cutting steels. Jones & Laughlin Steel Corp., Pittsburgh, Pa. (1210)

Value of Draft Control

Bulletin No. L-125 is devoted to the above subject and points out the proper value of the furnace draft and this company's control which consists of a draft switch, a damper motor and a manual station. Illustrated. Shallcross Controls, Inc., Milwaukee, Wis. (1211)

Ampco Metal

Engineering data of a general nature is offered in Catalog No. 21. Technical explanations have been written so that the layman may understand them. It is claimed that this metal is a "process metal" and not just "another special bronze." Illustrations. Ampco Metal, Inc., Milwaukee, Wis. (1212)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (1213)

What Scientists Say of Leitz Ultropak

Bulletin No. 17 describes the personal experiences and applications to which Ultropak has been placed by scientific workers in various fields. E. Leitz, Inc., New York, N. Y. (1214)

Centrifugal Compressors

Bulletin 386 is devoted to this company's Design 9 Compressors. Illustrated. B. F. Sturtevant Co., Boston, Mass. (1215)

Mallory Elkon

Looseleaf catalog containing engineering data with descriptions, illustrations and recommendations for the selection of electrical contacts for all types of service. P. R. Mallory & Co., Inc., Indianapolis, Ind. (1216)

Liquitol

Bulletin A1-16-A deals with the use of Liquitol for iron and steel castings and ingots. Alpha-Lux Co., Inc., New York, N. Y. (1217)

Dowmetal Data Book

A new edition of this book, containing especially significant accomplishments since the last data book, in the sections. Available Forms and Shop Practice has been published by The Dow Chemical Co., Midland, Mich. (1218)

Sonittep Products

This booklet discusses heat loss and its control. The advantages of Sonittep insulating cement and its uses are listed. Instructions for its application are included. Graphs. George F. Pettinos, Inc., Philadelphia, Pa. (1219)

Surface Hardening by Induction

The TOCCO Process which, it is claimed, reduces hours of surface-hardening time to seconds and produces a scientifically regulated, exact result, is discussed in an attractive illustrated leaflet of The Ohio Crankshaft Co., Cleveland, O. (1220)

Inhibitor

Grasselli 3 inhibitor for efficient, economical pickling is the subject of a booklet of The Grasselli Chemical Co., Inc., Cleveland, O. (1221)

Electro-Granodizing

This process which, according to the manufacturers, provides a rust-proof, paint-receptive surface combining the advantages and eliminating the disadvantages of other protective coatings in commercial use today is described in an illustrated leaflet of the American Chemical Paint Co., Ambler, Pa. (1222)

Heat Exchanger

Bulletin No. 173 describes the Duriron heat exchanger which is available in the company's corrosion-resisting alloys—Duriron, Durichlor, Durimet, Durco Alloy Steel and Alcumite. Illustrated. Duriron Co., Dayton, O. (1223)

Ferrocarbo

This material containing both silicon and carbon combined in the form of silicon carbide acts as a graphitizer or softener when added to cast iron. Carborundum Co., Niagara Falls, N. Y. (1224)

Cor-Ten and Man-Ten

Pamphlet describing high-tensile steels developed to meet the needs of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (1225)

MANUFACTURERS' LITERATURE

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (1226)

Fire Clay Products

A folder contains brief descriptions of the Goose Lake products and Therm-O-flake (for high temperature insulation) products. Illinois Clay Products Co., Joliet, Ill. (1227)

Coreless Induction Furnace

A colorful leaflet contains an explanation of the principles of operation and advantages to be obtained from the use of the Ajax-Northrup electric furnaces. Ajax Electrothermic Corp., Trenton, N. J. (1228)

Drop Forging Topics

Interesting articles are included in this illustrated publication of the Drop Forging Association, Cleveland, O. (1229)

Micromax Thermocouple Pyrometers

A new catalog, N-33A, explains the potentiometer method of measurement, the operation of the mechanisms through which this balance method is made available to industry. The complete line of instruments is set forth. Leeds & Northrup Co., Philadelphia, Pa. (1230)

Bolts, Nuts, Screws and Washers

A very complete catalog and price list of the above products is offered by The H. M. Harper Co., Chicago, Ill. (1231)

Aerocase

Booklet on this subject. Illustrations, curve charts, tables. American Cyanamid and Chemical Corp., New York., N. Y. (1232)

Yoloy

A colorful bulletin summarizes the properties of the above alloy steel and lists the physical properties of two typical steels in the Yoloy series. It is claimed to be corrosion resistant and to have high tensile strength and high ductility. Youngstown Sheet and Tube Co., Youngstown, O. (1233)

Furnace Element Construction

Bulletin HD-636 describes the development of the Hevi Duty element construction in furnaces. Some of the features of these elements are: freely radiated heat from the heating coils; coils are free to expand and contract; and tolerances are allowed for the free expansion of the radiant plates and tee supports and for normal growth of the coils. Hevi Duty Electric Co., Milwaukee, Wis. (1234)

Konik

Data on this steel's physical properties, corrosion resistance and working are offered by the Continental Steel Corp., Kokomo, Ind. (1235)

Armco H.T.-50

An illustrated folder devoted to the above alloy steel contains data on the average physical properties, corrosion resistance and forming and welding qualities. American Rolling Mill Co., Middletown, O. (1236)

Car Hearth Furnaces

Bulletin C-736 is devoted to these furnaces which were designed for uniform heating, sturdy construction and fuel economy. They can be built to use fuel oil, city gas, natural gas, butane or propane as fuel. Illustrated. The Philadelphia Drying Machinery Co., Philadelphia, Pa. (1237)

Granite City Hi-Yield 1 and 2

This company offers two types of high elastic steel which may be ordered in the regular or corrosion resistant grade. These steels are recommended for use, where abrasion resistance is required. Granite City Steel Co., Granite City, Ill. (1238)

High Temperature Insulation

For all types of heated equipment is the subject of an illustrated leaflet issued by Armstrong Cork Products Co., Lancaster, Pa. (1239)

Alloy Steels

A colorful folder devoted to these steels lists some of the advantages to be obtained by their use. Bliss & Laughlin, Inc., Harvey, Ill. (1240)

Electric Furnaces

A pamphlet describes the "Certain Curtain" furnace which was developed for heat treating at temperatures between 1850 and 2500 deg. F. C. I. Hayes, Inc., Providence, R. I. (1241)

Combination Impact Tester

This machine will make either izod, charpy, or tension tests quickly and accurately, and with minimum operator effort according to an illustrated pamphlet which is issued by the Riehle Testing Machine Div. of American Machine and Metals, Inc., East Moline, Ill. (1242)

Braze-Rite Furnace

This furnace, developed principally for brazing sintered carbide cutting tools, provides for localized heat to be applied only to the portion of the tool to be brazed. Illustrated. Firth-Sterling Steel Co., McKeesport, Pa. (1243)

Controlled Grain Anodes

Seymour Nickel Anodes are homogeneous in grain structure, according to this bulletin. The various available shapes are illustrated and some useful data are given. The Seymour Manufacturing Co., Seymour, Conn. (1244)

Centrifugal Castings

Bulletin C-2 is devoted to these castings which are available in the same analyses as the stationary-cast range of heat and corrosion resistant alloys which they supplement. Michigan Steel Casting Co., Detroit, Mich. (1245)

Multi-Rotary Table

The Wheelabrator multi-rotary table—the airless abrasive method of cleaning fragile or intricate metal parts—is described in Folder No. 33. Illustrated. The American Foundry Equipment Co., Mishawaka, Ind. (1246)

Heat and Corrosion Resistant Alloys Heated By Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (1247)

Brazing Alloys

The results of both laboratory and actual production data are contained in Bulletin No. 1 entitled "How to Use 'Handy' Silver Solders, Sil-Fos and Easy-Flo Brazing Alloys." Handy & Harman, New York, N. Y. (1248)

Fluxing, Deoxidizing and Hardening Alloys

Ajax alloys (phosphor copper, phosphor tin, nickel copper, manganese copper and silicon copper) are the subjects of a new leaflet issued by the Ajax Metal Co., Philadelphia, Pa. (1249)

Cutting Oils

A leaflet is devoted to the EFHCut series of oils. E. F. Houghton & Co., Philadelphia, Pa. (1250)

Stainless Steel Castings

An attractive booklet contains useful information on the subject. Typical analyses, characteristics and suggested uses are listed. Joseph T. Ryerson & Son, Inc., Chicago, Ill. (1251)

Bimetal

A simplified version of its manufacture and the way it works is contained in this pamphlet. W. M. Chace Co., Detroit, Mich. (1252)

3300 Deg. Super Refractory

An illustrated catalog devoted to "Shamva" Mullite contains information regarding its background, characteristics and uses. Mullite Refractories Co., Shelton, Conn. (1253)

Electric Welding Products

Catalog No. 101 contains information on welding rods (recommended uses for the different types, physical properties, welding procedure, etc.); miscellaneous apparatus, and Wilson arc welding machines. Air Reduction Sales Co., New York, N. Y. (1254)

Superficial Hardness Tester

Catalog Supplement RS-3 is devoted to this hardness tester, which is a special purpose machine, intended exclusively for hardness tests where only very shallow penetration is possible and where it is desired to know the hardness of the specimen close to the surface. Wilson Mechanical Instrument Co., New York, N. Y. (1255)

Firit

This protective coating for heat resisting parts used in foundries, steel and malleable plants, coke ovens, glass and ceramic plants, etc., is the subject of a leaflet. Foundry Services, Inc., New York, N. Y. (1256)

A. W. 70-90

This bulletin describes the new high-strength "70-90" steel in sheets and plates. An article on the engineering aspects of high-strength sheet steels is included. Alan Wood Steel Co., Conshohocken, Pa. (1257)

Application of Heat to Core Baking

A profusely illustrated booklet containing information resulting from research on the subject has been published by the American Gas Association, New York, N. Y. (1258)

Purifying Molten Iron

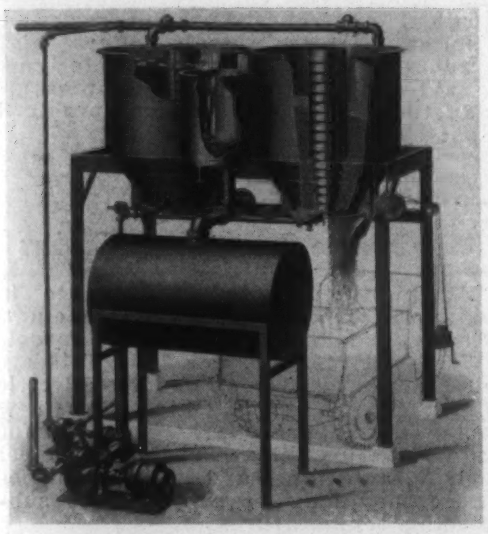
An iron finishing compound which is used in the pouring ladle for improving the castings is described in a pamphlet of The Maluminum Co., Indianapolis, Ind. (1259)

NEW EQUIPMENT AND MATERIALS

Multi-Louver Dewatering Tanks

The Claude B. Schneible Co., Chicago, announces a complete line of dewatering tanks for use with wet dust collector units. This new equipment known as the Schneible "Multi-Louver Dewatering Tank" is a specially designed unit for dewatering the accumulated sludge in the settling cone of multi-wash dust collectors. It is simple in design, has no moving parts other than the discharge gates, has nothing to break or quickly wear, and requires no care or attention other than the opening and closing of the valves, and opening of the gates in the discharging of the solids.

The method of operation is simple. Water containing solids enters the dewatering tank at the top through a baffled section which prevents undue disturbance of the water in the tank. A constant level is maintained in the tank at all times, the excess water flowing over a weir on the opposite side of the tank from the inlet. The overflow water enters a surge tank from where it is re-circulated in the dust collector system.



The low velocity of the water in the tank allows for complete precipitation of the solids in the area around the multi-louver cone in the center of the tank. When the tank is sufficiently filled with precipitated material, the inflow water is switched to another tank in the dewatering unit. After a short precipitation period, a valve on the line leading to the interior of the multi-louver cone is opened, and the head of water in the draining tank is allowed to recede slowly. The water flows out of the precipitated material and does not carry the material with it due to the angle of repose of the material against the multi-louver cones in the center of the tank. The final draining period will reduce the moisture contained in the sludge down to about 20 per cent, depending on the absorbent qualities of the material. When the sludge in the dewatering tank is completely drained, the bottom gates are dropped to allow the material to fill into a truck, railroad car, or other convenient receptacle.

Small rectangular tank dewaterers are used for use with installations where only a small amount of sludge is developed—railroad car type equipment being available for very large installations.

"HydroLectric" High Speed Presses

The Wood "HydroLectric" high speed presses are designed by the R. D. Wood Co., Philadelphia, for economic forming, stamping and drawing of metal sheets and also for straightening of malleable or steel castings and other heavy pressing operations.

Their speeds are said to equal or even exceed those of mechanical power presses, while maintaining all the advantages of hydraulic presses, via smoothness of operation, variable daylight and stroke adjustments to suit the work on hand, prevention of press or die breakage due to improper adjustments or over-loading, less rejects and better products.

The variable pressure and variable delivery, rotary piston pump is direct connected to an electric motor, both mounted on a rigid combination base and located close to the pre-fill tank. This type of pump with its controls permits quick changes of press tonnage and slide speed. As oil is being used as a pressure fluid, this has the additional advantage of preventing corrosion and freezing up, at the same time keeping all working surfaces and packings well lubricated. If a "dwell" on the work is required, an adjustable time delay is mounted on the press which automatically holds the full press on the work—for the length of time to which it has been set—before the slide automatically returns to its top position.

The press control is usually arranged for a semi-automatic cycle started by a hand lever or foot treadle and causing the press slide to make a complete approach, high pressure, and return stroke. However, if so desired, a full automatic cycle control can be furnished. With this control the press when once set in motion will repeat the above cycle over and over again until stopped by the operator, or set to a semi-automatic cycle.

For deep drawing these presses are preferably equipped with a hydraulic die cushion located in the press bed. This provides a means for clamping the blank, thus preventing wrinkling or tearing of the same during drawing operation. Die changes can be made quickly as no accurate adjustment of daylight or stroke is necessary and a convenient stroke control for die setting is provided.

Dowmetal for Hoover Castings

Dowmetal, the magnesium alloy rated one-third lighter than aluminum, invades the household appliance field for the first time with the announcement that the Hoover Company will use the metal in a newly developed vacuum cleaner.

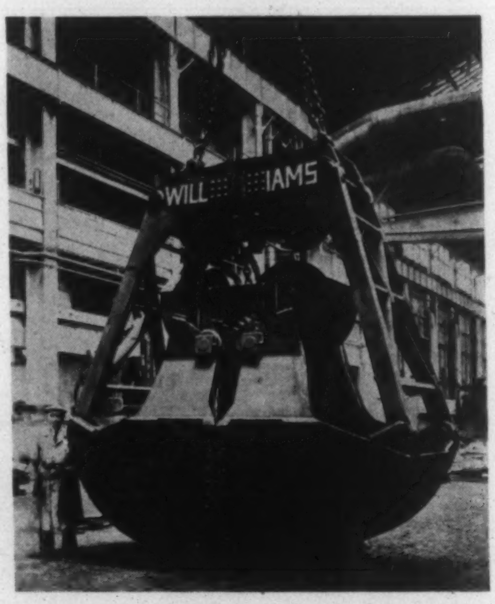
The announcement follows five years of experiments by Hoover and Dow Chemical Company engineers and the solution of vexing die-casting problems that have hitherto handicapped broad commercial applications.

New equipment and machinery to handle the metal has been installed at the Hoover plant at North Canton, Ohio, and the company is now turning out 5,000 castings a day. It is understood that extreme lightness will be one of the main sales points of the new cleaner.

Buckets of Low-Alloy High-Elastic Steel

The problem of handling seven tons of coal on a machine designed for six tons capacity has been solved in a 7-ton capacity "Williams" breakdown coal bucket recently constructed by The Wellman Engineering Co. of Cleveland for the Buffalo General Electric Co., which has placed the bucket in service unloading lake coal shipments at Buffalo.

Fabricated entirely of a nickel-copper alloy steel, "Yoloy," produced by The Youngstown Sheet & Tube Co., the bucket has jaws with a 16-ft. reach and grabs 8½ cu. yds. at one bite. Tests indicate that the steel has a resistance to atmospheric corrosion four to six times that of ordinary carbon steel, and possesses high resistance to impact both in the plate and weld. The bucket itself weighs 18,000 lbs. and has a yield strength above 60,000 lbs. and an ultimate strength of 90,000 lbs. per sq. in.



The Wellman company has also made use of this alloy in production of three cubic yard "Williams" clam shell buckets for handling zinc ore. A substantial increase in pay load has been made possible by holding weight of the bucket to 9,100 lbs.

An Aluminum De-gaser

To obtain perfectly sound aluminum castings it is essential to eliminate the gases already in the metal. After long, scientific research, the Foseco laboratories have perfected "Aluminum De-Gaser" to meet this need. It replaces the general method of applying such gases as chlorine or nitrogen, is more effective, convenient, simpler, and not dangerous to use. The Foseco Aluminum De-Gaser, based on the purifying effect of certain inert gases which are not soluble in aluminum, eliminates pinholes, removes gases present in metal or alloy, and improves the physical properties. It increases tensile strength 2 to 5,000 lbs. per sq. in., and shows an improvement in elongation of 20 to 30 per cent. It also improves the physical properties of silicon alloys when used before "modification." It is put out by Foundry Services, Inc., New York.

"Arcoloy," A Patented Metal

With the development of "Arcoloy," a new patented metal used for the manufacture of range boilers and storage tanks, the American Radiator Co., New York, announces the completion of the all-copper domestic hot water supply system. This development follows the introduction by this company within the past two years of a complete line of copper fittings for the complete copper in heating installation and it makes possible the use of a copper storage tank in radiator conditioning installations that include a domestic hot water supply.

Arcoloy range boilers and storage tanks for domestic hot water are made of 95 per cent pure copper with silicon, phosphor and other elements added to make a metal alloy which develops a corrosion-resisting skin when contacted by acids or alkalis. Arcoloy is said to have a higher resistance to ordinary corrosive agents than pure copper.

The rated gallon capacity of Arcoloy storange tanks is 25, 30, 40, 50, 60, 80 and 100 gal., while the range boilers are made with 25, 30, and 40 gal. capacities. All the tappings of both the boiler and storage tank are 1 in. iron pipe size.

Developed in the laboratories of the Products Development Division of the American Radiator Co., Arcoloy tanks and boilers have been field and laboratory tested for the past two years for resistance to corrosive material and for tensile strength. Sulphuric, nitric and other volatile acids and alkaline agents had practically no effect on the metal, and the tensile strength for ordinary boiler purposes averages from 55,000 to 65,000 lbs. per sq. in.

In all Arcoloy tanks and boilers no solder or any other metal is used in the construction. The tanks and boilers, guaranteed for 20 years against all normal water conditions and use, are electrically welded with Arcoloy welding rod and the spuds are made from forged Arcoloy.

Timken Sicromo Steels

To enable engineers and operators to achieve the economic balance essential to minimum production costs in refinery and other high temperature operations, The Timken Steel & Tube Co., Canton, Ohio, has developed a new series of steels, to be known as Sicromo 1, 2, 3 and 5. These new Timken high temperature steels extend the economic possibilities outlined by Timken DM Steel, the first Si-Cr-Mo alloy offered for high temperature use. Sicromo steels contain the 0.50 per cent Mo which has been found to be most effective for increasing creep strength on an economic basis. Their high silicon content develops the desired degree of oxidation resistance while economic resistance to corrosion is assured by the varying percentages of chromium indicated by the numbers.

Sicromo 1, 2 and 3 are particularly suitable for use in high temperature applications where low to medium oxidation and corrosion resistance is required. Sicromo 5 is designed for use where severe corrosion and oxidation is encountered, yet where equipment cost must be held to the minimum consistent with economic life and efficient operation.

Produced in electric furnaces under the most rigid chemical and metallurgical control, this new series of Timken Sicromo steels offers high grade, dependable alloy steels designed to aid those in the high temperature industries solve their tubing problems most economically.

New Freeze-Proof Water Coolers

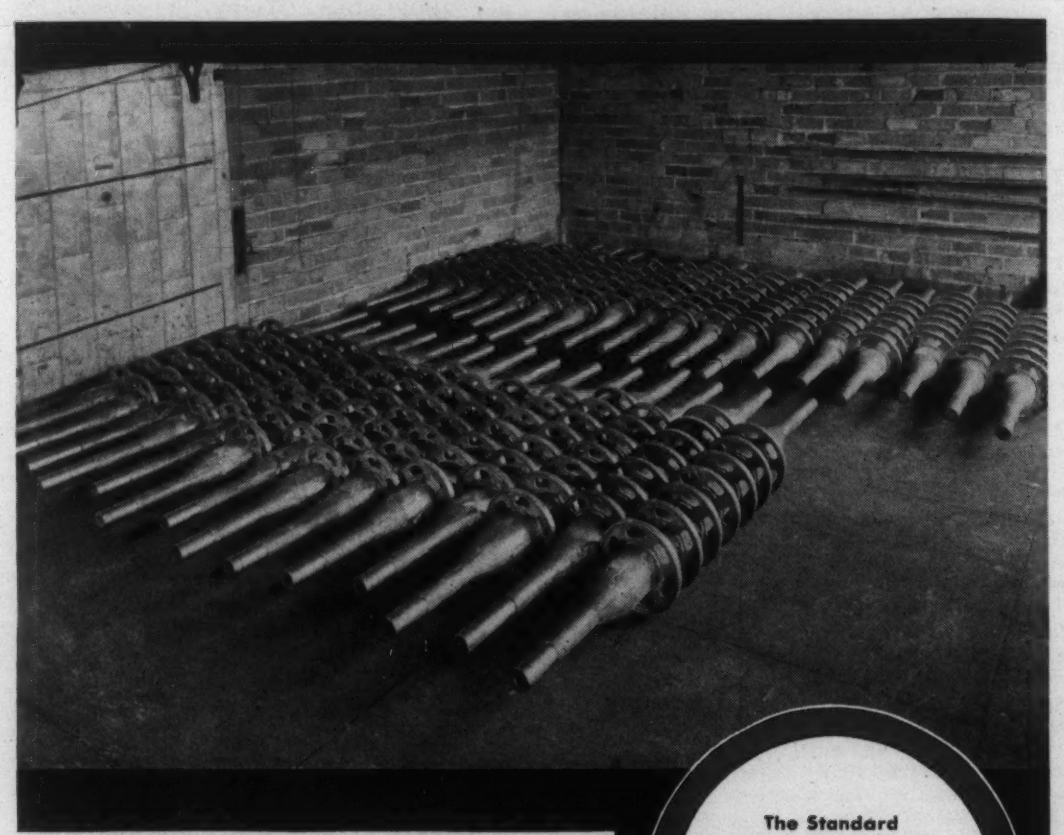
Especially designed to operate in temperatures below freezing, three new "Freeze-Proof" Water Coolers, models FWPF-8, FWPF-65, and FWPF-14 are announced by Westinghouse Electric & Mfg. Co., Mansfield, Ohio. These new coolers are particularly suitable for general industrial use such as in steel mills, factories, and other places where they may be subjected to subfreezing temperatures.

The coolers are especially insulated and equipped with thermostatically controlled Corox heating elements, mounted in the lower part of the cabinet. With this arrangement, these coolers will operate without freezing in temperatures as low as 20 deg. F. below zero. The model FWPF-65 Cooler has a capacity to cool 9.5 gal. of water per hour, from 70 to 50 deg.; the FWPF-8 Cooler delivers 11.9 gal.; and the FWPF-14 Cooler, 14.4 gal. per hr, under similar conditions.

An outstanding feature of these coolers is an improved type of dual-action cooling, eliminating the conventional type of pre-cooler, with its subsequent clogged drainage trouble. The dual-action principle is made possible by wrapping the incoming water line around the outside of the evaporator shell, to take advantage of the cold produced at the point to pre-cool the incoming water. This construction permits the use of a ¾ in. drain large enough to eliminate any possibility of clogging, which runs directly from the drain at the top of the cooler to the outside drain line.

Another exclusive feature in these new Westinghouse coolers, is incorporated in the cooling of motor, compressor, and condenser, by means of water. This water cooling system provides for increased capacity and freedom from clogged condensors.

All of these coolers carry a 5-yr. protection guarantee, and hermetically-sealed in mechanism, which consists of the motor and compressor sealed in an air tight armor of steel, with a lifetime supply of oil.



The Standard method of casting the central section insures uniformity in metal thickness and eliminates machining of the outside diameter of the shaft.

Standard Dry Shafts for Normalizing Furnaces

ARE you contending with the inefficiency of water-cooled shafting? An instance of much to lose and nothing to gain—certainly.

Standard Alloy Dry Shafts eliminate the expense and nuisance of water, as well as the attendant heat loss. Being centrifugally cast, they are straight, solid, homogeneous, uniform in thickness, nonwarping, free from inclusions. The end bearings are separate and sometimes can be used again.

Savings of 25% in fuel alone are typical. Why not record these economies in your 1937 profit column?

STANDARD ALLOY COMPANY, Inc.
1679 Collamer Road Cleveland, Ohio

Standard invites your correspondence relative to the manufacture of high grade heat-resisting alloy castings.

Standard service is based upon sound specialization. Standard pours only nickel chrome alloy.

STANDARD Heat-Resisting CASTINGS
NICKEL CHROME ALLOY

Extended Range of Fafnir Roller Bearings

A complete series of heavy-duty industrial roller bearings, made in an extended range of almost a hundred sizes, is now being manufactured by The Fafnir Bearing Co., New Britain, Conn. The rated capacity of these bearings ranges from 10,000 to 500,000 lbs., depending upon size, speed and loading conditions. The series is said to cope fully with the severe service requirements of paper mills, steel mills, and other heavy metal-working machinery, rubber and oil field equipment, and the like.

In the widened range of bearing sizes, rollers of ¾ in., 1¼ in. and 1½ in. diameter have been utilized, in addition to the 1 1/16 in. diameter used in the bearings previously available. A choice of 18 different bores is now offered in bearings of this type.

A feature of these roller bearings is the large number of solid rolls which are incorporated in the cage assembly, thus making for increased load capacity. The cage itself is fabricated from specially form-rolled spacer bar stock, with carburized and hardened end rings. Rollers are held in place and guided by spacer bars rather than by rivets through the rolls themselves, which of necessity tend to weaken the capacity of the roll. The spacer bars of the Fafnir cage are riveted to the end ring, and the accurate assembly of these bars keeps the rolls permanently aligned.

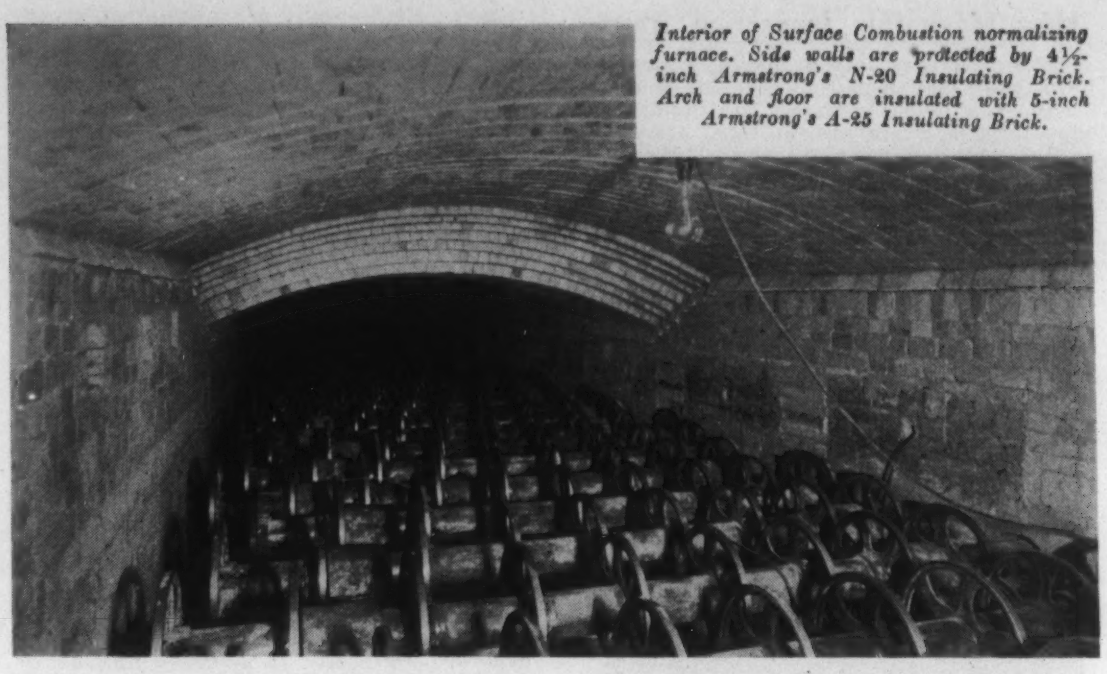
The entire roller assembly is made with a fixed radial clearance to allow for the expansion which takes place when the inner ring is shrunk to the shaft, this being the standard method of mounting for the roller type bearing. This clearance likewise permits the bearing to operate successfully and without impairment should temperature differentials occur in actual operation—that is, a certain amount of expansion due to heat, as is the case with dryer rolls, for example, can be taken care of without seriously affecting the relationship of the bearing parts.

All parts of these roller bearings are precision-ground, and held to extremely close tolerances. Complete specifications, including dimensions, tolerances and load ratings, are available on request.

A Metal Marking Machine

The Quality Dye Co., of 9314 S. Baltimore Ave., South Chicago, has introduced a new multiple wheel (non-automatic) metal marking machine, having features which offer the following advantages: All mechanism completely enclosed; instant changing of serial readings; turning of one wheel at a time while others remain locked, and positive locking of all wheels, once serials are selected, insuring proper alignment.

The machine is particularly desirable for serial marking in steel mills, foundries, forge-shops, machine shops and other heavy duty service in production plants. The wheels are made of tool steel and hardened. The numerical digits are deeply engraved on the circumference of the wheel and will withstand use on metal up to 415 Brinnell hardness. Characters to be stamped can be arranged in a straight line in any combination. Indicators are provided to locate position of marking. Impressions are made by hammerblow. The machines are available with four or more wheels and with figures ranging in size from 1-16 to ¼ in. or over. Literature is available by addressing the manufacturer.



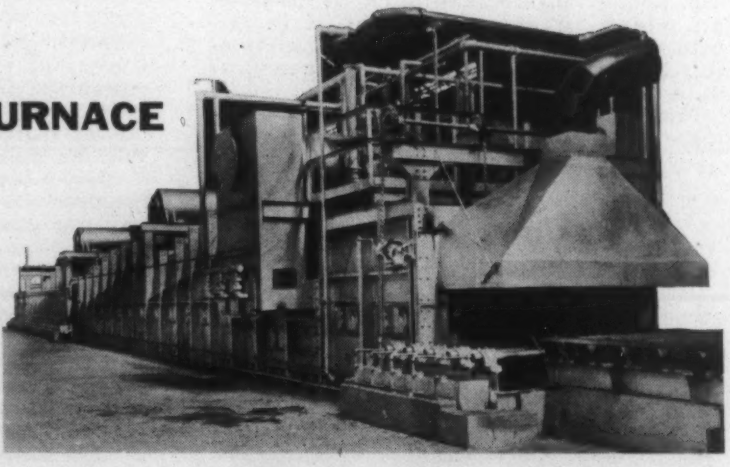
Interior of Surface Combustion normalizing furnace. Side walls are protected by 4½-inch Armstrong's N-20 Insulating Brick. Arch and floor are insulated with 5-inch Armstrong's A-25 Insulating Brick.

ARMSTRONG'S BRICK HELP MAINTAIN

Close, Accurate Temperature Control

IN THIS GIANT

NORMALIZING FURNACE



Surface Combustion's new furnace serves double duty. When normalizing, it operates at 1,900° F., and can turn out 21,800 lbs. of tin plate per hr. And when used as a blue annealer, it operates at 1,650° F., with a capacity of 38,000 lbs. per hr.

THIS new S C disc type normalizing furnace, built by the Surface Combustion Company, of Toledo, Ohio, is believed to be the widest dry shaft furnace of its kind.

In its operation, Armstrong's N-20 and A-25 Insulating Brick help maintain constant, uniform temperatures, and guard effectively against B.t.u. losses. Behind a refractory, Armstrong's N-20 shows no shrinkage at 2,000° F., at which temperature it has a crushing strength of 300 lbs. per sq. in. Armstrong's A-25 will not crack, fuse, or spall, behind a refractory, at temperatures as high as 2,500° F. Its crushing strength is 225 lbs. per sq. in. when cold, 265 lbs. at 1,800° F., and 91 lbs. at 2,100° F.

Armstrong also manufactures N-16 Insulating Brick for temperatures up to 1,600° F., and two Insulating Fire Brick—EF-22 and EF-26—semi-refractory brick for temperatures up to 2,200° F., and 2,600° F., respectively. Write for new descriptive folder. Armstrong Cork Products Co., Building Materials Div., 982 Concord St., Lancaster, Pa.

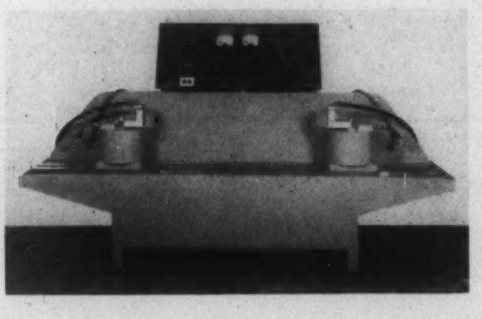
Armstrong's

HIGH TEMPERATURE PRODUCTS

New Magnaflux Inspection Units

Two new production inspection units have been developed by the Magnaflux Corp., New York., during the past year especially for the automotive, aircraft, and machine parts industries. Magnaflux unit D-301 operates on 60 cycle alternating current and is adapted to the detection of defects regardless of the direction in which they occur. This unit can be used for both magnetizing and demagnetizing the part. It also has an added advantage in that it is operated by a foot pedal. The magnetizing heads may be adjusted to accomodate parts up to 72 in. long.

Magnaflux unit DY-703 has been designed particularly for the inspection of crankshafts of larger size than can be accommodated in the D-701 unit. This unit can also be used for magnetizing and demagnetizing and it is also provided with an open grill table top underneath which is constructed a receiving tank. This permits the inspection of the part by the wet method without removing the part from the unit. The Magnaflux bath liquid is flowed over the part and collected in the receiving tank.



Rotary Louvre Dryers Now a Link-Belt Product

Announcement is made by Link-Belt Co., 300 W. Pershing Road, Chicago, that it has acquired the manufacturing and sales rights for North America, for the Dunford & Elliott rotary louvre dryer, of which many installations have been made in Europe, Canada and Japan.

It is being offered for the drying of all types of granular materials, coarse or fine, or of irregular shape, size and consistency; all types of crystals and powders manufactured or used in the chemical industry; factory refuse and waste; vegetable products, etc. It has also been employed as a heating or cooling unit; as a general reaction vessel; and for evaporating liquids on a solid substance. Among the materials handled are coal, coke, clay, fertilizers, grain, ores, cereals, salt, sand, sugar, wood chips and bark, cement clinker and all manner of chemicals.

The dryer is described briefly as a mechanically rotated horizontal drum with a series of internal channels near the circumference, into which hot air is admitted from a fan. These channels are covered by tangential plates which overlap in such a way as to leave a gap for hot air to pass from the channels into the inside of the drum and into the material contained therein, and at the same time prevent any material from falling backwards. The channels are tapered so as to give the inner lining of the drum a gentle slope from the feed end to the discharge end. As the drum revolves, fresh channels come underneath the charge, but, as the hot air can only enter the channels when they are actually underneath the charge, all the gases must pass upwards through the bed of material.

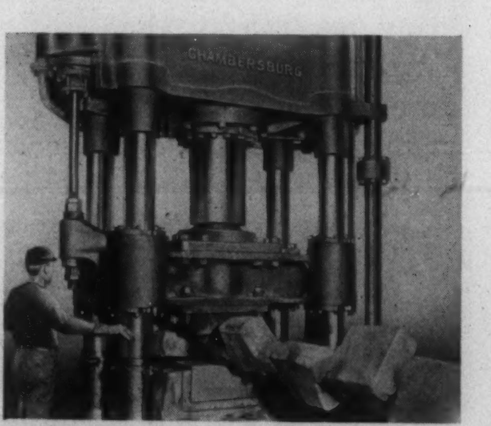
High-Speed Forging Press

Heavy forgings are forged quickly and economically to a close degree of accuracy by the high-speed steam-hydraulic forging presses recently added to the line of the Chambersburg Engineering Co., Chambersburg, Pa. These presses are manufactured and sold by the Chambersburg company by arrangement with the United Engineering & Foundry Co., Pittsburgh, Pa., and under Davy Bros., Ltd., patents.

The Chambersburg "United" steam-hydraulic forging press is built in two general styles: The single-frame and the four-column models. Both embody the same principles and application, the difference being only in capacity and physical features. The essential elements are the press, the steam intensifier and the water reservoir or prefiller tank.

Close control of the intensifier or forging stroke is attained by a controlling gear attached to the intensifier which operates to close the steam valve at a point of the intensifier stroke corresponding to the position of the hand lever. Thus a slow movement of the hand lever results in a correspondingly slow squeeze of the press, and stopping the movement arrests the action of the press. This gives the operator complete control of the action of the machine, a particularly valuable feature when cutting off or when a bending operation is being performed.

The single-frame press is built in 150-ton and 500-ton sizes. This type is particularly suitable for railroad and other repair shops where a variety of bending, forming and forging operations are performed. The four-column model is built as a single-cylinder press up to the 1500-ton size and as a duplex ram press from 2000-ton capacity upwards.

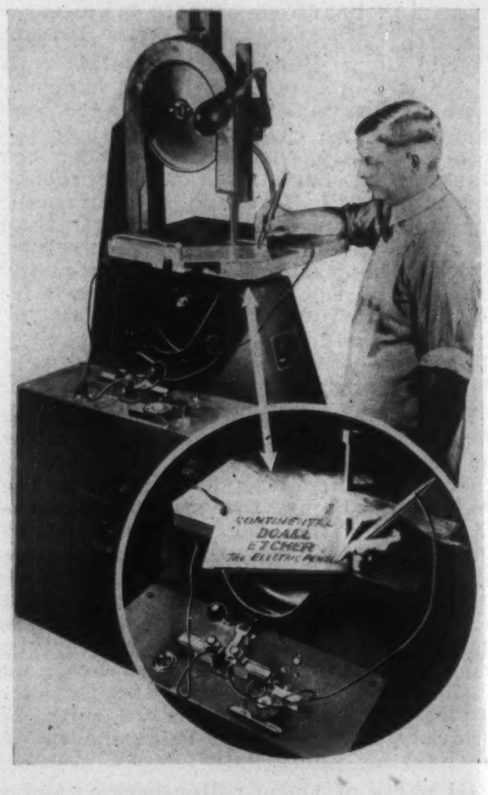


These presses embody a patented steam saving device, utilizing exhausting steam for useful work at the beginning of the following lifting or pressing stroke, produces a saving in steam consumption averaging 25 per cent of the consumption of any other make of steam intensifier. Another valuable feature of this system is a marked increase in speed of operation.

Doall Etching Pencil

A new "electric pencil" known as the "Doall Etcher" has just been placed on the market by Continental Machine Specialties, Inc., of Minneapolis, Minn. Writing on steel, with the electric pencil, is a process of arc welding, in which the tip of the pencil vibrates to permit the miniature arc to be interrupted and produce the etching effect.

In the Doall Etcher an entirely new principle is used to accomplish the vibration of the point of the pencil. A special coil in the pencil is attached directly on to the writing point. The point is made of pure tungsten to resist heat and wear. The pencil is operated from the transformer built into the company's Doall sawing, filing, and polishing machine. The principal function of this transformer is to weld or braze the precision metal cutting band saws used in the machine. The brazing transformer is especially suited to the requirements of the electric pencil, because it has low voltage and high amperage; the current being regulated with a 3-"heat" switch, shown in the lower illustration. Thus any desired degree of intensity for the etching arc may be attained.



The Doall Etching pencil is furnished with Doall machines. The slogan "takes the job right through" is borne out to completion with the addition of this new product. This machine tool now not only fabricates a piece from a roughing out to final polish, but marks the piece for identification.

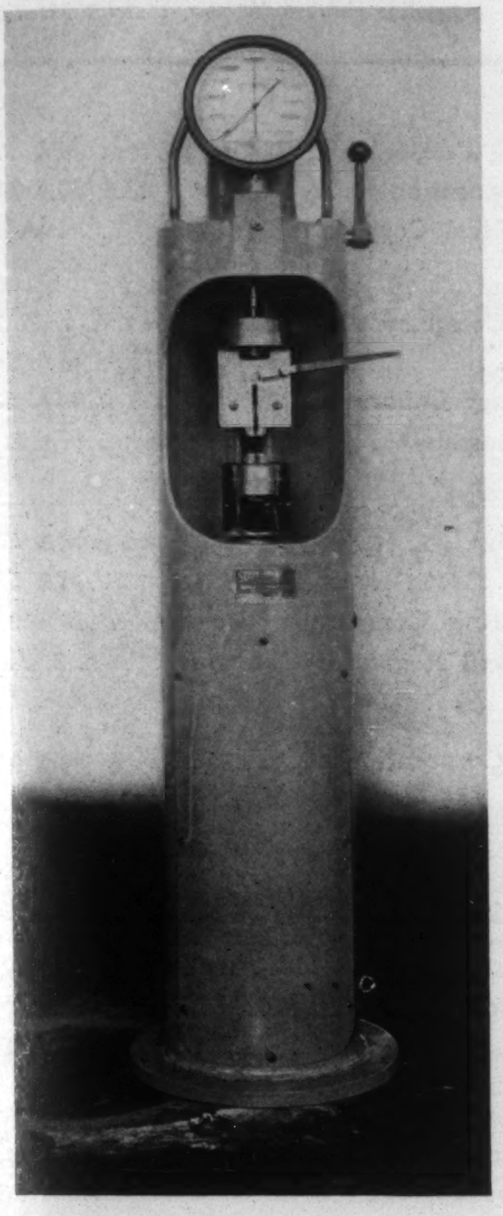
Acme Colored Superstrip Strip Steel

Acme Steel Co., Chicago, announces "Acme Colorstrip"—cold rolled strip steel in colors. Practically all colors and shades can be reproduced. Of particular interest to users is that the small extra cost of this attractive lacquered strip steel is only a fraction of the cost to produce the same effect on the product after forming.

Acme Colorstrip (as it is termed) will withstand bending, drawing and forming. Hence considerable interest in this new product is anticipated. This new departure, it is believed, will have an important bearing on product cost which has had to be colored after forming. This expense will be avoided with Acme Colorstrip.

Spot Weld Testing Machine

A new hydraulic machine for accurately testing the strength of spot welds has been developed and built by the Baldwin-Southwark Corp. of Philadelphia for the Edw. G. Budd Mfg. Co., Philadelphia, well known manufacturers of the streamlined Zephyr trains and automobile bodies.



This completely new 10,000-lb. hydraulic tension testing machine is of the most modern design and its rugged, fool-proof design makes it an invaluable piece of equipment where constant testing to insure proper welding strength is necessitated. The machine is supplied with a round base for rolling from place to place and a hoisting hook for moving with a crane. With an overall height of 70 in., an 18-in. diameter steel base, a low center of gravity, and weighing approximately 800 lbs., this completely self-contained spot weld tester is ideal for portable service. An 8-in. precision dial indicates the load. The cylinder is located at the top of the machine and has a 4½-in. diameter ram with a 2-in. stroke. Fluid under pressure is pumped by a gear pump situated in the base of the machine. This pump is direct connected to a ¼ h.p. motor.

A specially designed type of self-aligning, lever operated, renewable file-face grips is used. These grips are so designed that hard sharp faces can be quickly installed at a very low cost, being made of short sections of machine cut files. The upper grip is of the open face type, while the lower grip is of the closed type with wide angle entrance. These grips will accommodate offsets in welded specimens from the smallest gage to ¼-in. thick without using backing plates or liners. Specimens up to 1¼-in. wide can be tested. Balanced grip holders are cut from solid blocks of high carbon steel. Top and bottom handling levers are set at right angles, thus affording convenient operation. All working parts of the machine are easily accessible by removing the front cover plate. Although primarily intended for the services above, the Southwark spot weld tester is a convenient and inexpensive machine for all sorts of tensile testing.

Bright Zinc Plating

A more extensive use of zinc plating for production of attractive and durable rust-resistant surfaces on a wide variety of steel articles has been made possible through development, by the R. & H. Chemicals Department of the du Pont company, of an improved barrel plating process which uses a new brightening agent. The new process is claimed to be particularly adaptable to use in barrel plating of building hardware, radio parts, electrical fixtures and other metal equipment where attractive appearance is important. It is said to be quite resistant to finger staining.

The product and the process have been thoroughly tested and are now being used with success by a number of commercial plating establishments. This new and brighter zinc plating is a natural extension of the first commercial and practical process for bright zinc plating which was brought out by the du Pont company about a year ago meeting the immediate need for an inexpensive, durable, decorative metal surface for steel articles.

All of the practical and economic advantages of the original bright zinc plating are retained in the modified method. Only small quantities of the new brightener are introduced into the regular plating solutions. No radical changes in plating practices are involved. Flat and irregular or deeply recessed steel articles are given a high uniform luster. This brighter deposit, like that obtained with the old process, also resists corrosion.

The new brightener is a liquid, easy to handle and control. In addition to being non-corrosive, it is non-inflammable and non-toxic. Consequently, it adds no complications or hazards to the bright zinc process while meeting the demand for a protective finish high in appearance value.

Two Plastic Refractory Materials

Two new plastic refractory materials, known as "Champion Furnace Patch" and "Champion Ramming Mix," especially developed for high temperature melting furnaces, are announced by the Champion Spark Plug Co. and the Detroit Electric Furnace Co., Detroit, from whom they may be obtained.

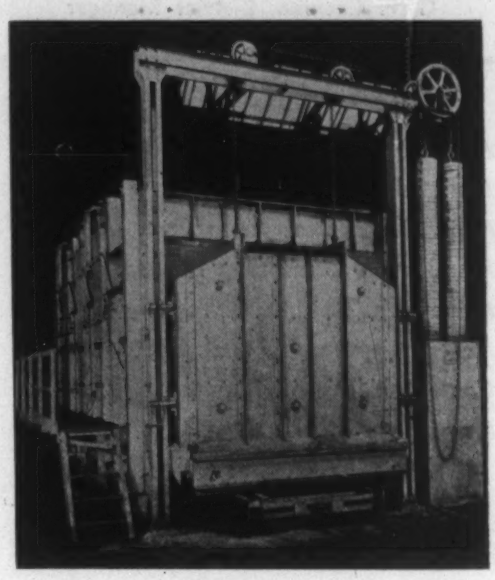
Ceramic engineers of the Champion Spark Plug Co. have developed a plasticizing process for andalusite base mullite. The results are available in two forms, a plastic ramming mix and a plastic patch or cement. The materials are similar chemically but differ in screen size, the ramming mix being of coarser texture, adapted for ramming deep patches or monolithic linings.

Champion refractories have been in use by scores of electric furnace users for a number of years. This recent improvement lowers the labor cost of the installation and secures for the user a better and longer lasting refractory. Prices of the new refractory have also been reduced.

"Plastic Mix" and "Plastic Patch" have been field tested in a number of difficult melting operations. Uniformly favorable results have been reported by users.

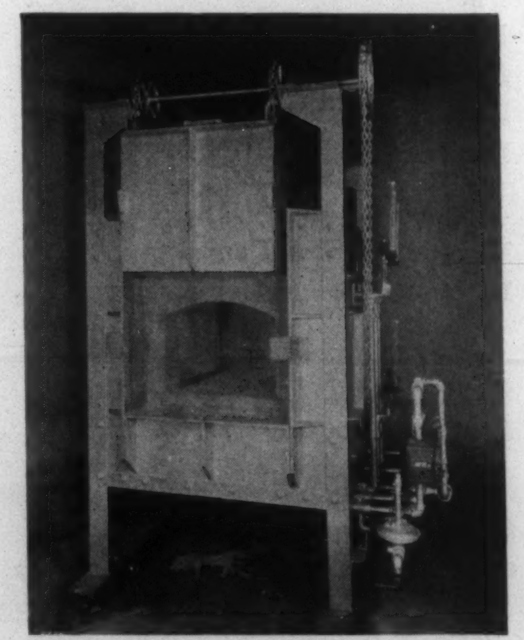
A Car Hearth Furnace

Car hearth furnaces of improved design and materials are producing high fuel economy, uniform temperature distribution, close control of both temperature and atmosphere with wide range of temperature operation allowing for several heat treatments in the same furnace, with low first and operating costs. Two or more cars can be supplied for continuous furnace operation. Standard "PDM" combustion equipment can be supplied for oil, gas (artificial or natural) and propane. This includes burners, automatic temperature and furnace pressure controls. Alloy hoods or covers can be supplied for special atmospheres during the heating and cooling cycle. Hoods, with or without insulation, can be supplied for controlled cooling. This furnace is a product of the Philadelphia Drying Machinery Co., Philadelphia.



A Box Type Furnace

PDM box type furnaces of improved design and material, offer high fuel economy, uniform temperature distribution, close control, wide range of temperature operation allowing for several heat treatments in the same furnace, with low first and operating costs, and are manufactured in 18 standard sizes by the Philadelphia Drying Machinery Co., Philadelphia. They can be supplied with oil, gas or propane burner equipment, also automatic temperature and atmosphere control, and with insulating refractory brick or fire brick linings.



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1. ORE CONCENTRATION

JOHN ATTWOOD, SECTION EDITOR

Ore Dressing Research—Results of Tests at Kalgoorlie and Melbourne. W. G. Clark. *Chemical Engineeering & Mining Review*, Vol. 28, June 8, 1936. Reports are reviewed of ore dressing tests on the following ores: (1) sulphide Au ore from Yellowdine mine, (2) Au ore from Weerianna and Nicol mines at Roebourne, W. A., (3) pyritic Au ore from Slippery Gimlet mine, W. A., (4) pyritic Au ore from Hill 50 mine at Mt. Magnet, W. A., (5) Au ore from Prohibition mine at Meekatharra, W. A., (6) complex Au ore from Snake Valley mine near Ballarat, Vic., and (7) sulphide Au ore from Mt. Freda, Queensland. Cyanidation and flotation data are given. WHB (1)

Sluicing for Gold and Tin—The Operations of Cock's Pioneer. G. B. O'Malley. *Chemical Engineering & Mining Review*, Vol. 28, June 8, 1936, pages 289-294. An historical sketch and description of present sluicing operations. The yield and treatment costs of the present operating company are tabulated. WHB (1)

Milling Practice Little Long Lac Gold Mines Limited. Neville S. Spence. *Canadian Mining Journal*, Vol. 57, Aug. 1936, pages 363-70. Milling practice is outlined. The conclusions drawn from 3½ months' work are: (1) the arsenopyrite is the refractory Au-bearing mineral in the ore, (2) finer grinding will not liberate this Au nor will stronger cyanide dissolve it, (3) the Au in the arsenopyrite exists in some chemical or physical state such that it is bonded to its host mineral and it is due to a change in the physical characteristics of the mineral that the Au is amenable to cyanidation, (4) by removal of the sulphides from the present plant tailings, sweet roasting this concentrate, and then cyanidizing the roasted product, the overall extraction may be raised by about 5%, giving a total extraction over 92%. The flowsheets show the cyanide circuit, the refinery, the flotation of cyanide residues and the roaster calcine treatment. WHB (1)

Concentration of Loparite Ore. Ya. P. Kim. *Redkie Metallui*, Vol. 5, Jan.-Feb. 1936, pages 26-34. In Russian. This ore, containing the mineral loparite, contains 0.45% rare earths and 0.15% $Ta_2O_5 + Cb_2O_5$. Concentration on tables followed by magnetic treatment yielded a product containing 23.25% rare earths and 7.75% $Ta_2O_5 + Cb_2O_5$ with a recovery of 68%. HWR (1)

Loloma Treatment Plant—Roll Crushing, Drying, Roasting, Cyaniding. *Chemical Engineering & Mining Review*, Vol. 28, July 8, 1936, pages 347-350. The treatment of ore of the Loloma (Fiji) Gold Mines, Ltd., Tavau is outlined. The whole feed is roasted after fine crushing in rolls, followed by cyanidation of the calcine. The flowsheet and plan of the treatment plant are shown. WHB (1)

■ 1a. Crushing, Grinding & Plant Handling ■

Selection of Ore-Crushing and Grinding Equipment. Joseph E. Kennedy. *Mining & Metallurgy*, Vol. 17, Mar. 1936, pages 139-140. Discusses crushing and grinding equipment suitable for preparing run-of-mine ore for concentration, amalgamation, flotation, or cyanidation. Important factor is the tonnage to be dealt with. For large plants suggests a large jaw or gyratory crusher for reducing to 8"-10" or finer. In open pit work, using power shovels, jaw crusher should have an opening of 48" by 60", or 60" by 84". Best type of feeder to ball or rod mill is the disk. Special type of fine grinding gyratory permits the reduction of 2½" or of suitable character to as fine as 90 mesh or finer. Small size crushers are suitable for use in handling ore in closed circuit with classifier and a ball or rod mill. Belt conveyors are preferable to elevators. VSP (1a)

■ 1c. Flotation ■

Modernization Revives an Old Grass Valley Mine. John B. Huttl. *Engineering & Mining Journal*, Vol. 136, Mar. 1936, pages 145-146. A 3-year program of underground exploration and development, followed by erection of a modern flotation mill, rehabilitates the Spring Hill mine unworked nearly 60 years. WHB (1c)

1e. Amalgamation, Cyanidation & Leaching

Ore Treatment at the Reduction Works of the Transvaal Gold Mining Estates, Limited. C. G. Brink. *Journal Chemical, Metallurgical & Mining Society South Africa*, Vol. 36, Feb. 1936, pages 203-214. The ore at Central Mines contains graphite which, unless removed, causes premature precipitation of dissolved Au. Paraffin (0.4 lb./ton) added to the pulp in the tube mill floats off the graphite in the water overflowing the collectors. The paraffin has no injurious effect upon precipitation in the Zn boxes, nor does it retard amalgamation. Settlement of slimes is improved. Certain Cu ores, such as malachite, consume less cyanide after paraffin treatment. Lime added to the pulp after leaving the mill increases amalgamation recovery by 6%. Au recovery by amalgamation is 40%. Sand forms 18.5% of the tonnage, it receives 10 days treatment; 3 lbs. of dissolved $Pb(NO_3)_2$ is added to each new charge. The slime receives 22 hrs. agitation; concentration is maintained at 0.045% NaCN and 0.01% CaO. The long period of agitation is essential owing to the slowness with which the Au is dissolved in the presence of Cu and Ag. In strong cyanide solutions Cu interferes very little with the normal working of the Zn boxes, but if the free cyanide content is low, the Zn is coated with an adherent film of Cu and Au precipitation is reduced. Consumption of reagents, per ton milled, is Zn 0.36 lb., NaCN 2.5 and lime (65% available CaO) 12 lbs. Oxygenation reduces cyanide consumption and increases Cu and Ag recovery in the Zn boxes to 90%. Brief descriptions of flow sheets at 2 other mines are given. AHE (1e)

2. ORE REDUCTION

A. H. EMERY, SECTION EDITOR

■ 2a. Non-Ferrous ■

Direct Production of Electrolytic Copper Plates. *Metal Industry*, New York, Vol. 33, Nov. 1935, pages 395-396. Current density, voltage, $CuSO_4$ and acid content must be controlled in order to produce Cu plates by direct electrodeposition. Circulation of the electrolyte is necessary. CBJ (2a)

The Rhokana Electrolytic Copper Refinery. Archer E. Wheeler & Henry Y. Eagle. *Bulletin Institution Mining & Metallurgy*, No. 380, May 1936, pages 1-15. Discussion. See *Metals & Alloys*, Vol. 7, Aug. 1936, page MA 396R/4. AHE (2a)

Some Improvements on the Electrolytic Refining of Copper at Hitachi Mine. H. Isituka. *Journal of the Mining Institute of Japan*, Vol. 51, Nov. 1935, pages 677-690. The direct production of anodes from converter is preferred generally in Japan on account of the high cost of fuel compared to that of labor. Converter-anodes are classified according to the degree of blowing and the appearance of their surfaces as (A) an under-blown variety containing excess S, (B) a moderate one with 0.05% S and (C) an over-blown one with more than 0.5% S. (B) gives the best results with respect to power consumption (450 kw. hr./1 ton of Cu; formerly 600 kw. hr.) the rate of dissolution and the loss of Au and Ag. 55° C. is the best temperature for the electrolyte. Se extraction increased from 55% to 80% by the use of a special sublimation apparatus and Cottrell treaters. Blue vitriol crystals were made practically free from Fe (0.02% Fe). The hexa-hydrate method was adopted in the manufacture of $NiSO_4$ and the content of Zn diminished to 0.01%. YO (2a)

Novelty in Zinc Metallurgy (Nouveauté en métallurgie du zinc) O. Dony-Henault. *Revue de Métallurgie*, Vol. 3, July 1936, pages 422-426. Brief sketch dealing principally with New Jersey Zinc Co. distillation process. JDG (2a)

Making Ferromolybdenum without External Heat Application. *Kachestvennaia Stal*, Vol. 4, No. 2, 1936, page 55. In Russian. Roasted MoS_2 concentrate containing 68.3% MoO_3, 72% Fe-Si, CaF_2 and Fe scale was ground and thoroughly mixed. A sheet steel conical mold, containing a primer of 50 g. Al + 190 g. KNO_3 was imbedded in sand. After ignition with a Mg wire the mixture was added gradually. The alloy produced was sound and uniform, not differing in appearance from electric steel, and assayed 65% Mo, 0.01-0.10 C, 0.18-1.03 Si, traces to 0.1 S. 6 laboratory heats with 20 kg. each of MoO_3 and 5 semi-production heats using 150 kg. each of concentrate showed a general recovery of 94.5%. The following mixture is recommended for 65% alloy: 1.26 calcined concentrate (80-85% MoS_2), 0.5 of 72% Fe-Si, 0.3 Fe scale, 0.2% steel scrap, 0.15% fluorspar. (2a)

■ 2b. Ferrous ■

Iron and Steel. *Times [London] Trade & Engineering*, Vol. 38, Jan. 1936, page XVI. Review of British developments in plant and research during 1935. MS (2b)

Probable Development of Blast Furnace Lines (Le developpement probable du profil des haut fourneaux) E. Cotel. *Revue de Métallurgie*, Vol. 33, Apr. 1936, pages 253-257. Present biconical shape of blast furnace cross section is an unjustified survival of middle ages. Much evidence indicates that a total elimination of boshes and the use of a straight line profile is more advantageous than the present lines, particularly when the shaft flares upwards. Rachette type of furnace might come back. JDG (2b)

Arc Furnaces for Ferroalloy Production by Ore Reduction (Fours à arc pour la production de ferro-alliages par reduction des minerais) M. Kauchtschischwili. *Journal du Four Electrique*, Vol. 45, Apr. 1936, pages 125-126. Translation from *Siemens-Zeitschrift*. See *Metals & Alloys*, Vol. 6, July 1935, page MA 273R/8. JDG (2b)

Sponge Iron. *Foundry Trade Journal*, Vol. 54, Jan. 16, 1936, page 73. In a new German process for the manufacture of sponge Fe (D.R.P. 617942), Fe ore is briquetted (with a small amount of C if necessary) and reduced with CO, H or a mixture of these gases or other hydrocarbons, in a vertical or shaft furnace, in such a way that about halfway down the furnace the ore reaches its highest temperature, being then cooled to nearly atmospheric temperature by a cold blast of reducing gas admitted at the base of the furnace. The Fe is extracted from the furnace as sponge. Cooling before leaving the furnace is necessary to prevent the oxidation of the hot sponge on coming in contact with the air. AIK (2b)

Determination of Humidity of Dust-containing Gases (Die Bestimmung des Feuchtigkeitsgehaltes technischer staubhaltiger Gase) Alfred Schwartz. *Messtechnik*, Vol. 12, July 1936, pages 144-146. Electric psychrometers are suitable if they are enclosed in a dust-proof case. The application for blast-furnace gases is described. Ha (2b)

Making Alloy Steels Using Cast Irons Bearing Chromium and Nickel. A. K. Silin. *Kachestvennaia Stal*, Vol. 4, No. 4, 1936, pages 25-26. In Russian. High strength steels can be made directly in an open hearth furnace by using Fe rich in Ni and Cr. A run of 20 heats was made in a 20 ton basic open hearth furnace using Fe containing 0.7-0.8% Cr and 1.20% Ni. Good results could be obtained using a charge consisting of as much as 90% of this Fe. Cr is removed completely in the first slag. Then a lime slag is built and the heat finished as usual. Steels of SAE type 3115-3145 of good quality were produced without difficulty. (2b)

3. MELTING, REFINING AND CASTING

A Plea for Loam Moulding. Robert Liddle. *Foundry Trade Journal,* Vol. 54, Apr. 9, 1936, pages 283-286. Paper read before Scottish branch, Institute of British Foundrymen. Author believes that loam molding is very safe, and the castings produced equally good, when compared with those molded by other methods. Standardized equipment, cylinder molding, core-making, assembling the mold, core assembly, patternmaking, finishing operations, high-pressure cylinders in loam, template details, etc., are discussed by the author. AIK (3)

Modern Coreshop Production. W. H. Smith. *Foundry Trade Journal,* Vol. 54, Apr. 9, 1936, pages 279-281; Apr. 16, 1936, pages 301-303. Paper read before Birmingham branch, Institute of British Foundrymen. Reference is made to the principal elements in coreshop production and the methods adopted by a few of the more progressive foundries. In the opinion of the author, taking the industry as a whole, the coreshop has so far not received the consideration its importance in modern foundry production calls for. Sand distribution to coremakers, coreboxes, handling green sand cores, etc., are discussed. AIK (3)

Cores Made with Sulphite Liquor. I. A. Chistov. *Liteinoe Delo,* Vol. 7, No. 5, 1936, pages 13-14. In Russian. Sand mixture selected contained: 100% sand, 5-7% clay, 5-7% sulphite liquor (sp.g.1.3) and 1% heavy oil. Cores produced were much stronger than the average permitting elimination of steel reinforcements. (3)

Rational Shape of Sink Heads. D. A. Popov & B. N. Scherbachenko. *Liteinoe Delo,* Vol. 7, No. 5, 1936, pages 24-28. In Russian. Experiments conducted with casting stearine in sheet Fe molds indicate that the best efficiency of a sink head is obtained when the ratio of its volume to the surface is at a maximum. (3)

The Technique of Powder Metallurgy. Charles Hardy. *Mining & Metallurgy,* Vol. 17, Mar. 1936, pages 145-146. Abstract of a paper read before the Chicago section of the American Institute of Mining Engineers, Feb. 1936. Powder metallurgy is the production of semi- or fully formed metal products by compressing metal powders. Principal metal powders are produced by electrolysis or by reduction of metal oxides by gases. Purity of metal powder is of great importance, and also the control of particle structure, size and fineness. Compression of powder involves consideration of compression ratios, dies and presses. Density of pressed article is controlled by selection of the powder density and regulation of compression ratios. Dies are made of special die steels. Pressures used vary from 2 to 75 or 100 tons/in.^{2}. Compressed pieces are heat treated which is a sintering process. Gives various applications of compressed powders. VSP (3)

Core Prints. N. A. Sokolov. *Liteinoe Delo,* Vol. 7, No. 6, 1936, pages 23-25. In Russian. Standards recommended and adopted are given. (3)

A Laboratory Vacuum Casting Furnace. Jack H. Scaff & Earle E. Schumacher. *Metals & Alloys,* Vol. 7, Aug. 1936, pages 204-206. Describes laboratory apparatus for melting and casting metals under pressures of 0.01 to 0.08 mm. of Hg. Inductive melting is employed. WLC (3)

Composition and its Effect upon the Properties of Mould and Core-Sand Mixtures at Elevated Temperatures. F. Hudson. *Foundry Trade Journal,* Vol. 54, 1936, June 11, 1936, pages 458-460; June 25, 1936, pages 502-505, 510. Paper presented at the annual conference of the Institute of British Foundrymen in Glasgow. This paper is a continuation of a previous paper on "Some Properties of Mould and Core Materials at Elevated Temperatures" (*Foundry Trade Journal* Dec. 5, 1935). The following main points were brought out by this investigation: Many of the mold and core compositions used in the foundry trade have unsuitable properties at elevated temperatures. These unsuitable properties are characterized by excessive expansion and cracks, strains and inherent stresses, hot tears and pulls and dimensional inaccuracies between casting and pattern. The results obtained indicate that a certain coal-dust addition imparts the necessary properties at elevated temperature to green sand. Sawdust additions are most satisfactory for dry sand and loam. The paper also indicates the effect of other materials which can be alternatively added to promote better properties at elevated temperatures. The paper is illustrated with a number of diagrams. AIK (3)

Develops a New Type of Enclosed Hinge. *Foundry,* Vol. 64, June 1936, page 74. Describes a new type of hinge or knuckle joint developed by J. F. Hines Mfg. Co. Hinges may be cast in Al, brass, malleable Fe, steel, high test Fe, bakelite, etc. Can be made in any size or shape for use on seagoing vessels or railroad rolling stock. Principle is adapted for casting chains in Al, brass, steel, etc. Gives details of construction. VSP (3)

Cross Section of Sprues and Filtering Screens in Gating Systems. S. I. Bernstein. *Liteinoe Delo,* Vol. 7, No. 6, 1936, pages 17-19. In Russian. A series of experiments showed that the cross section of sprues can be reduced to almost 40% of that of the gates before the metal loses its head in casting. (3)

Die Castings. Herbert Chase. *Aero Digest,* Vol. 29, July 1936, pages 54, 55. General discussion of use and properties for aero applications. WB (3)

Nomograms in Casting Practice. A. A. Rijhikov. *Liteinoe Delo,* Vol. 7, No. 6, 1936, pages 20-22. In Russian. Nomograms for calculation of composition, making charges and determination of the weights necessary for weighing molds are given. (3)

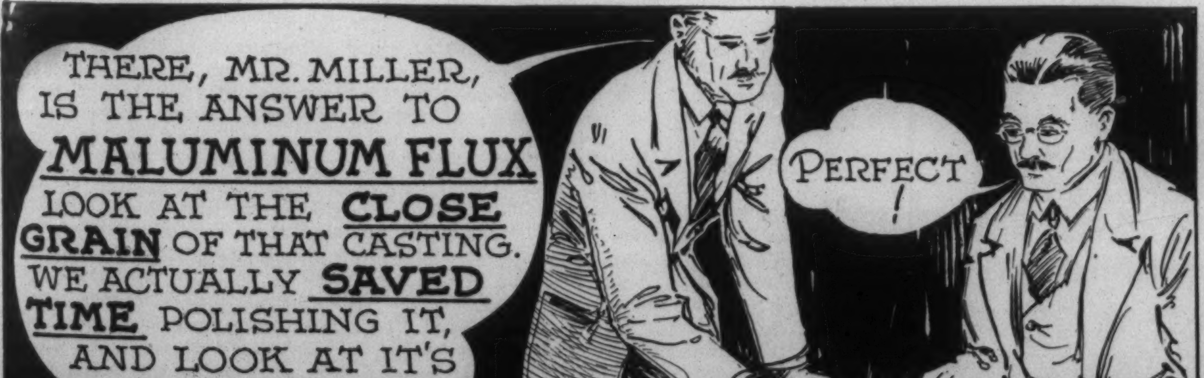
■ 3a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

Practical Aspects of Die-Castings. N. G. D. Robertson. *Foundry Trade Journal,* Vol. 54, Apr. 23, 1936, pages 317, 318. Paper read before a joint meeting of the London branches of the Institute of Metals and British Foundrymen. Numerous machines have been designed for producing die-castings. In some of these the metal is forced into the die by a piston, in others by compressed air. In the vacuum process the metal is drawn into the die by applying a vacuum. The gravity process should not really be classified as a type of die-casting and the American term "permanent mold casting" is more suitable. Metals of high melting temperatures such as brass and bronze are now being cast by the pressure process. However, the surface of brass pressure castings is not in any way as good as in brass gravity castings, and certainly not as fine as in some of the alloys with lower melting points. Brass gravity die-castings are the most difficult to produce, except perhaps in very simple shapes. Pressure die-castings can be made to closer limits than gravity castings. Die-casting can seldom compete with sand casting in the production of castings that require no machining. See also *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 440R/5. AIK (3a)

Inverse Segregation and the "Perspiration" (Tin Sweat) of Bronzes (La Segregazione Inversa e i "Trasudamenti" dei Bronzi) G. Somigli. *Industria Meccanica,* Vol. 18, June 1936, pages 347-355; July 1936, pages 424-434. According to new experiments, the cause of inverse segregation of bronze must be solely ascribed to the action of enclosed gas. The Ludwig-Soret effect, although theoretically valid, has no practical importance as there is not sufficient thermal gradient during the casting period for it to establish itself. The contraction accompanying solidification has an indirect effect only while the gases dissolved during melting and escaping during solidification determine, but do not regulate the intensity of inverse segregation. Contraction due to shrinking is not sufficient to determine the causes for perspiration (tin sweat) because sweating does not take place when the dissolution of gases is eliminated. The method of presolidification followed by remelting under suitable cover is practically sufficient to avoid inverse segregation even in bronzes with high P content. 25 references. Ha (3a)

Rules for Pouring Bearings with Babbitt metal (Leitregeln für das Ausgiessen von Lagerschalen mit Regelmetall) E. T. Richards. *Werkstatt und Betrieb,* Vol. 69, July 1936, pages 183-184. Failure of Babbitt is often attributed to the composition and general qualities of the Babbitt metal, but it also depends on a number of other circumstances such as pretreatment of the bushings, proper cleaning, etching, pickling and tinning. Pouring temperatures are: bushing 260°-300° C., Babbitt metal 350°-400° C., cores or mandrels with brass bushing 125°-150° C., with steel or cast Fe bushing 240°-250° C. Too cold mandrels cause hard and brittle surfaces of the Babbitt, too hot mandrels lead to too great diameter. Vibration should be avoided during solidification. HR (3a)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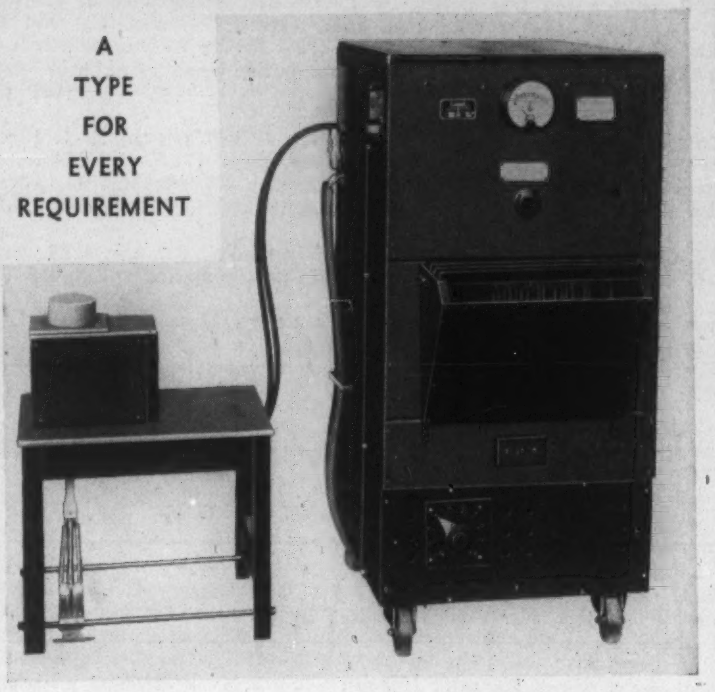

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Evolution of Die Casting (L'evolution de la Coulée en Coquille) G. RIVOIRE. *Revue de Fonderie Moderne,* Vol. 30, Apr. 25, 1936, pages 138-140. A brief review of die casting, especially of Al, Al-Zn and Al-Cu, and of the development of the metal molds and possible further developments is given. Ha (3a)

Copper as a Mould Material. Applications in the Casting of Metals. A. J. MILLER. *Metal Industry,* London, Vol. 48, June 26, 1936, pages 705-710. I. General applications. Although molds of Cu were employed during the Bronze Age, it is only recently that Cu has been used extensively as a material for molds and bottom plates. The Cu-producing industry was the first to abandon cast Fe molds. Cu-bottom plates were used extensively in the latter part of the last century. The reactions between C and surface oxides, resulting in "blown" surfaces, was largely the reason for the substitution of Cu for Fe molds. The gradual method by which this substitution was made is indicated. The Junker water-cooled type, introduced about 1926, is considered as the first type of Cu-mold to be used economically. A more robust type, developed by the American Metal Co. in 1929, is made of solid Cu. II. Advantages of copper as a mold material. The high thermal conductivity of Cu is a major factor in making it a superior mold material. Cu of a high purity should be used as some impurities, such as As, when present even in very small quantities, tend to decrease this conductivity greatly. Advantages obtained are more uniform rate of solidification, improved surface of cast material, and longer service life of the molds. The behavior of different mold materials are compared. III. Description of Copper Molds and Bottom Plates used in Practice. Specific instances are cited in which the methods of using Cu-molds by different companies are described. These include (1) the casting of Cu in horizontal solid Cu-molds, (2) solid and water-cooled Cu-molds for vertically cast Cu-cakes, billets and wire bars, (3) Cu-molds for casting Cu-alloys, and (4) Cu-molds and bottom-plates for casting other metals. Illustrations showing various types of molds are included. 16 references. HBG (3a)

Founding Aluminum Bronze Castings. M. T. GANZAUGE. *Foundry,* Vol. 64, June 1936, pages 24-25, 82, 84. From paper read before the American Foundrymen's Association at Detroit. Deals with the practical phases of the founding of Al bronze for high pressure work. VSP (3a)

Cast Bronze Parts for Pumps. PAT DWYER. *Foundry,* Vol. 64, June 1936, pages 32-33, 90. Describes the production of rotary power driven pumps by the Northern Pump Co., Minneapolis. Gray Fe and steel castings are procured from local foundries, while non-ferrous castings are made by a subsidiary, the Northern Foundry Co. Bronze compositions are melted in 2-500 lb. capacity electric furnaces. To insure correct chemical and physical properties, over 25 standard alloys have been developed. Twin core ovens take care of the output of 5 coremakers. Products for the U. S. Navy, specification 46M6C, calls for minimum tensile strength of 40,000 lb./in.^{2}, minimum elongation of 20% in 2". The composition of metal is: Cu 86-89%; Sn 8.00-11.00%; Zn 1.00-3.00%; and impurities maximum 0.5% Special methods of molding, gating and feeding have been developed. VSP (3a)

Some Aspects of Non-Ferrous Founding. A. LOGAN. *Proceedings Institute of British Foundrymen,* Vol. 27, 1933-34, pages 483-511. See *Metals & Alloys,* Vol. 5, Sept. 1934, page MA 431. CEJ (3a)

Studies in Cast Bronzes. F. W. ROWE. *Proceedings Institute of British Foundrymen,* Vol. 27, 1933-1934, pages 318-332. See *Metals & Alloys,* Vol. 6, Apr. 1935, page MA 139. CEJ (3a)

Melting Magnesium Alloys in Gaseous Atmosphere. K. V. PEREDELSKI. *Liteinoe Delo,* Vol. 7, No. 5, 1936, pages 33-36. In Russian. Mg-Al alloys were melted under H_2 and H_2S. Physical properties of H_2 treated metal were slightly better than H_2S treated. No S inclusions were found under microscope, though analysis showed 0.03-0.04% S. (3a)

Some Factors which Influence Soundness in Non-ferrous Castings. A. LOGAN. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 683-706. See *Metals & Alloys,* Vol. 6, Oct. 1935, page MA 390. CEJ (3a)

Non-Ferrous Castings. A. LOGAN. *Foundry Trade Journal,* Vol. 54, Mar. 19, 1936, pages 231, 232, 234. Extended abstract of the paper which was read before the East Midlands Branch of the Institute of British Foundrymen. Methods of melting, cost of melting, development of light alloys, piston alloys, "Y" alloy, "R.R." alloys, ceralumin alloy, Al-Si and Mg alloys are discussed by the author. AIK (3a)

Investigations on the Casting of German Silvers (Recherches sur la Coulée des Maillechort) M. BALLAY & R. CHAVY. *Cuivre et Laiton,* Vol. 9, June 30, 1936, pages 271-276; July 30, 1936, pages 319-325. The properties and defects occurring in castings of Ni (German) silver are discussed and furnaces used for melting described. It is most important, in order to obtain a sound casting without gas inclusions, to add an easily oxidizing metal which eliminates the gas; Mg, Mn, Al, Si give good results. Al and Mg in excess, however, make the metal viscous. Mn avoids this inconvenience but is less active than Al. Good results are obtained with 0.3-0.5% Mn added as cupro-manganese (30% Mn), or metallic Mn. Al as metal or cupro-aluminum should be added in an amount of 0.02-0.03%. Addition of 0.3% Mn, followed by an addition of 0.015% Al as cupro-aluminum (50% Al) or even 10-15% Al is particularly recommended. The additions should be made when the pouring temperature has been attained but by no means before. Pouring temperature should be no less than 1250° C., and for low Zn contents at least 1350° C. Molding sands should be more refractory than for usual foundry purposes, and if the castings are used for decorative purposes, without machining, a fairly fine-grained sand should be employed. In order to accelerate cooling and to avoid porosity it is advisable to mix 3-5% graphite with the sand to increase its thermal conductivity. Molds and cores should be carefully baked; a sand consisting of 80% silicious and 20% yellow sand, agglomerated with linseed oil and dextrine is particularly suitable in this case. Practical hints for molding and casting are given. The corrosion resistance of Ni silver increases with Ni content. Alloys with 20% Ni and 5% Zn are used more frequently in America while in Europe the Zn content is usually 12-30%. Diagrams of hardness as a function of composition, and tables of mechanical properties are added. 20 references. Ha (3a)

Sand Casting Copper-Silicon Alloys, H. A. Bedworth & V. P. Weaver. *Foundry,* Vol. 64, July 1936, pages 24-26, 59. Alloys are principally Cu alloyed with Si plus one or more additions to enhance their properties, particularly those rendering them suitable for the manufacture of castings. Alloys are melted in crucible furnaces or in electric furnaces. During melting metal is protected by some gasless flux, such as ordinary bottle glass. Molding in general follows closely the practice used for gun metal. Cores are made from open, sharp sand with linseed oil binder. Molds should be rammed lightly to improve permeability. To secure sound castings metal should be poured rather hot and should have high sprues. Metal should be poured slowly especially in the case of large castings. Cu-Si alloys are readily machinable where proper procedure is followed. Cu-Si alloys are non-rusting. Includes a table giving the approximate physical properties of a 95% Cu, 4% Si and 1% Mn alloy. VSP (3a)

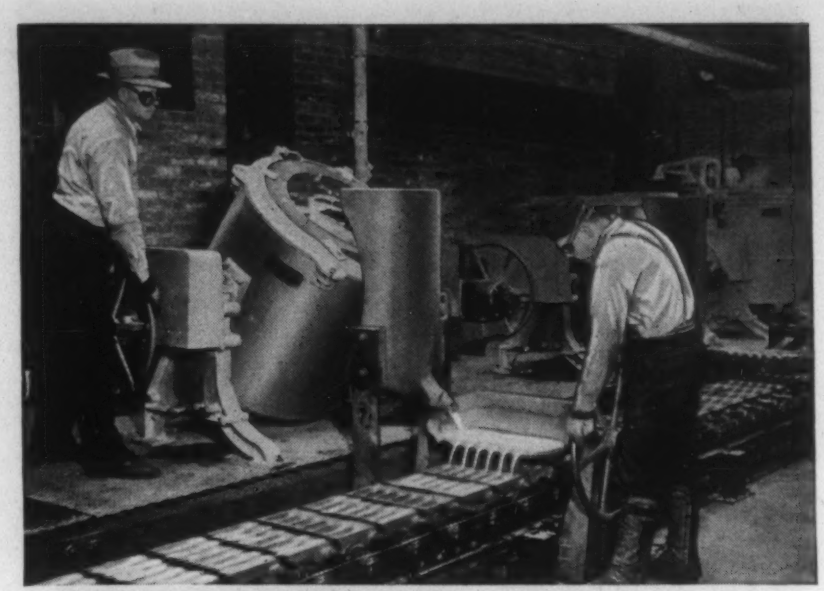
Precious Metals Refinery of the Mond Nickel Co. (La refineria de metales preciosos de la Mond Nickel Co.) C. Busquet. *Metalurgia y Construccion Mecanica,* Vol. 2, Sept. 1936, page 1. Description of the precious metals refinery at Acton (England). A splendid example of results obtained by applying the regular chemical analysis laboratory procedure to the industrial recovery of such precious metals as Ag, Au, Pt, Pd, Ir, Rh and Ru. FRM (3a)

Manganese Bronze and Brass. Wesley Lambert. *Proceedings Institute of British Foundrymen,* Vol. 28, 1934-1935, pages 712-730. See *Metals & Alloys,* Vol. 6, May 1935, page MA 179. CEJ (3a)

3b. Ferrous

C. H. HERTY, SECTION EDITOR

Slag Inclusions in Acid Steel. Yu. T. Lukashevich-Duvanova & P. S. Germant. *Kachestvennaia Stal,* Vol. 4, No. 3, 1936, pages 45-54. In Russian. 4 15-ton acid open hearth heats were comprehensively investigated in regard to their non-metallic inclusions. The latter were separated from the metal by dissolving in a mixture of 10% HNO_3 and 10% citric acid solutions, and electrolytically in a solution containing 3% $FeSO_4$, 1% NaCl and 0.2% ammonium citrate. They were studied under a microscope and analyzed by means of differentiated solution (Yu. T. Lukashevich-Duvanova, *Zavodskaia Laboratoria,* Nos. 1 and 2, 1934). Amount and type of inclusions produced during melting and present in the finished metal is about the same. The size of inclusions depends on the cooling rate. Slag is highly dispersed in the metal in molten state. The degree of dispersion or solubility of slag in molten metal is defined by slag concentration in the bath. On addition of deoxidizers character of slag inclusions changes slowly and gradually, within 30-40 minutes. Original slag is present in transparent globules of silicates changing on addition of deoxidizers to dark granular silicates. Al_2O_3 inclusions are present in the bath from the beginning as well as magnetic Fe oxide, observed in solidified samples. Distribution of slag along the depth of the bath is haphazard. (3b)



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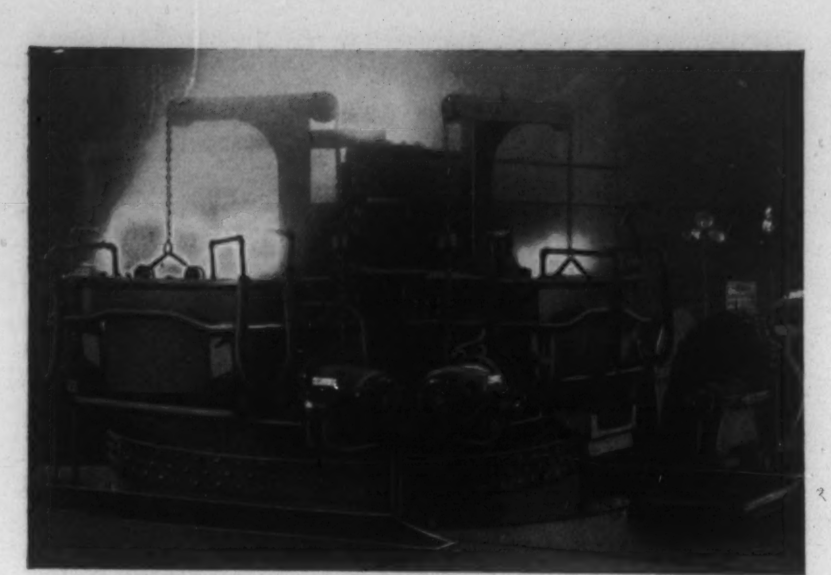

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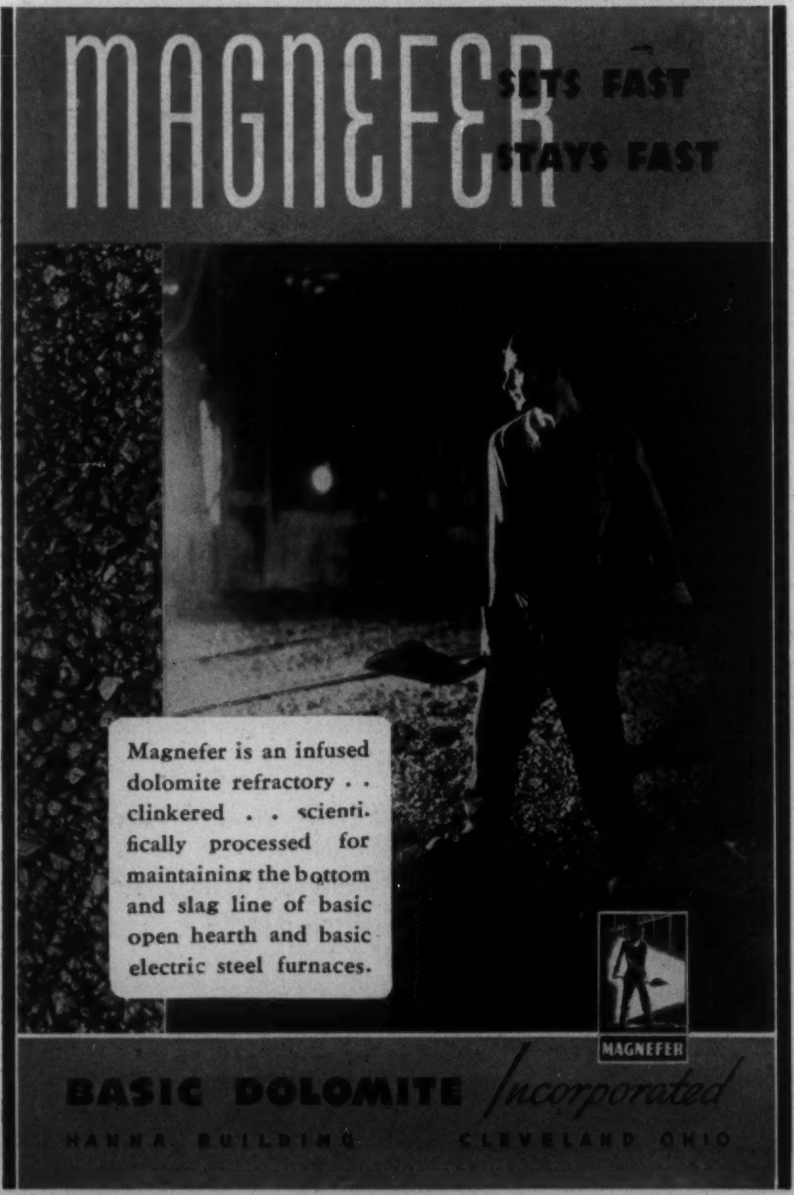

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3b. Ferrous

C. H. HERTY, SECTION EDITOR

Production of Nickel-Chrome-Molybdenum Steel Castings from a Bessemer Converter. J. FLACK. *Foundry Trade Journal,* Vol. 54, May 21, 1936, page 399. An entry in the short paper competition held by the Birmingham branch of the Institute of British Foundrymen. Most of the Ni-Cr-Mo steels were made by the crucible, open-hearth or electric furnace processes, and the converter process was introduced experimentally, but proved so successful that it can now compete with the other processes as a commercial proposition. Plant, molding and foundry conditions, heat-treatment, structure and type of castings are discussed. AIK (3b)

Refining Iron to the Malleable Condition. WM. MCCONNACHIE. *Blast Furnace & Steel Plant,* Vol. 24, Feb. 1936, pages 141-144, 148. Discusses oxidation of metalloids in steel-making processes and the action of O_2 and H_2O in the blast in the Bessemer process. Free O_2 acts on everything with which it comes in contact. That part of the O_2 in the blast in the combined form oxidizes some C, Si, etc. but no Fe. Oxides of Fe produced by blast act on Si and perhaps Mn resulting in recovery of some of the oxidized Fe. In addition, CO and H_2 throw down more Fe from the oxides. If slaked CaO could be safely introduced with the blast, there would be greater yields, as the H_2O would act selectively on the impurities without oxidizing the Fe, while the H_2 formed could reduce the oxides produced. CaO would combine with the SiO_2, leaving FeO free to be reduced by Mn, Si, or C, and the gases. Slag consisting of Ca SiO_3 would be no more corrosive on the converter lining than the usual $FeSiO_3$ or $MnSiO_3$.
MS (3b)

Ironfounding and Engineering. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XXIV. Outlines foundry industry of Sheffield, England.
MS (3b)

Soda Treatment in Iron Metallurgy (Le traitement sodique en sidérurgie. Observation. Résultats) ACHILLE G. LEFEBVRE. *Revue de Métallurgie,* Vol. 33, May 1936, pages 289-290. Na added to molten Fe forms very fusible slag which washes away non-metallic inclusions besides reducing S content. Granulated soda ash is preferably added when Fe is tapped from the blast furnaces, though it might be used in remelting. Original paper was presented at the Mining & Metallurgical Congress in Paris in Oct. 1935. JDG (3b)

A Defect in the Foundry: The "Egg Shell" (Un Défaut de Fonderie: La "Coquille d'Oeuf") GUY HÉNON. *Revue de Fonderie Moderne,* Vol. 30, Jan. 25, 1936, pages 19-23. "Egg shell" is the name of a defect in casting which consists in a very thin casting skin sticking to the surfaces of certain cored pieces; the skin is 0.5-1.0 mm. thick, and forms particularly on surfaces of an oval shape, whence the name. The study of this phenomenon showed that an accumulated amount of P is found in the shell and that the casting is pronouncedly pearlitic and has, therefore, a wide range of Ar transformation. Means to avoid this defect are (1) to make the solid layer on the core dense and uniform, the corners of the core should be cooled by cooling tubes. (2) A more ferritic than pearlitic structure is better as it has a lower expansion and therefore fills the mold better in cooling. (3) The solidification should take place isothermically by limiting the temperature interval between crust and core of the piece. The conditions are discussed at length and illustrated by micrographs. Ha (3b)

Properly Constructed Gate Delivers Clean Metal to the Mold. A. J. CASSISTA. *Foundry,* Vol. 64, Mar. 1936, pages 34, 78, 80. Describes various methods of pouring metal into mold to insure elimination of dirt and slag in castings. Considers various skimming equipment and its proper use. VSP (3b)

Benefits from Corrugated Molds. EMIL GATHMANN. *Blast Furnace & Steel Plant,* Vol. 24, Apr. 1936, pages 326-327. When corrugations are of suitable design, quality can be greatly improved and chipping costs reduced considerably for all types of steel. Salients should be made as deep as practical to obtain maximum volume of initial solidification, but yet sufficiently shallow to prevent occurrence of dangerous stresses during the shrinkage that takes place throughout solidification period, as well as to obviate excessive decarburization of surface during reheating. Mold walls must be of sufficient thickness and heat-absorptive value that there can be no appreciable distortion of mold-matrix contour at any time during entire period of ingot's solidification. Shows horizontal cross-section of a mold contour embodying these requirements. MS (3b)

Electric Reheating of Ingot and Casting Sink Heads (Réchauffage par l'arc électrique des masselottes des lingots et des moulages) LEOPOLD GRANGER. *Revue de Métallurgie,* Vol. 33, Apr. 1936, page 243. Application to the sink heads of electric arc of a small intensity, about 100 KW keeps the metal liquid and reduces losses to about 5% of the weight of ingots. The simplest electrical equipment is satisfactory. JDG (3b)

Cast Iron Pulleys for Wire Ropes (Report of the Wire Ropes Research Committee of the Institution of Mechanical Engineers) *Bulletin British Cast Iron Research Association,* Vol. 4, Oct. 1935, pages 214-217. Review of report. See *Metals & Alloys,* Vol. 7, June 1936, page MA 285L/1. WB (3b)

The Work of the Heterogeneity of Steel Ingots Committee. W. H. HATFIELD. *Iron & Steel Institute,* Special Report No. 12, May 1936, 43 pages; *Iron & Coal Trades Review,* Vol. 132, Apr. 3, 1936, pages 617-618; *Metal Progress,* Vol. 29, May 1936, pages 76, 83, 84, 86; *Iron & Steel Industry,* Vol. 9, Nov. 1935, pages 57-65. A summary of work previously reported by the Committee. The Committee was formed in 1924 and 6 reports, beginning in 1926, have been issued. One of the major findings of the Committee was that the character of the liquid steel resulting from the steel-making reactions determines the degree and nature of heterogeneity resulting from the mechanism of freezing. The contents of previous reports and descriptions of ingots studied are listed.
JLG + Ha + WLC + CEJ (3b)

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4. WORKING

Working Copper and Copper-zinc Alloys. William Ashcroft. *Metallurgia,* Vol. 14, Aug. 1936, pages 99-100. Brief discussion of hot and cold working and annealing. JLG (4)

Making Stainless, Acid Resistant and Heat Resistant Steels in the United States. F. F. Khimushin. *Kachestvennaia Stal,* Vol. 4, No. 2, 1936, pages 7-16. In Russian. Description of American practice based on published data and on author's observations. (4)

■ 4a. Rolling ■

RICHARD RIMBACH, SECTION EDITOR

Bakelised Bearings for Rolling Mills. *Engineering,* Vol. 141, May 29, 1936, pages 593-594. Describes the Metrovick bakelized bearings, and gives brief account of manufacture and performance. VSP (4a)

Use of Tapered Roller Bearings in Gear Reduction Units. S. M. Weckstein. *Steel,* Vol. 98, Apr. 20, 1936, pages 30-36. Paper read before the American Gear Manufacturers Association. Includes some consideration of designs used on rolling-mill drives. MS (4a)

The Rolling of Sheet and Strip. A. L. Molineux. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 61-66. Compares equipment and arrangements of rolling mills of earlier days with those of today and points out the advantages of current methods. The sizes of the different types of mills, their purposes and methods of operation are indicated. HBG (4a)

Spreading of Metals in Rolling. P. A. Aleksandrov & N. F. Lashko. *Kachestvennaia Stal,* Vol. 4, No. 4, 1936, pages 20-29. In Russian. A comprehensive analysis of the problem supported by experiments resulted in the following tentative formula

$$B_1 - B = cf \frac{(H - h)}{H} \sqrt{R(H - h)}\, e^{-bT}$$

in which symbols are the same as in Siebel's formula, coefficient *f* can be determined experimentally and *b* is phase constant. 24 references. (4a)

Some Considerations Influencing Plant Facilities for Strip-sheet Production under British Conditions. Geo. A. V. Russell. *Iron & Coal Trades Review,* Vol. 132, May 8, 1936, pages 835-840. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 401L/3. Ha (4a)

Wire Presses and Hot-mills for Working of Non-ferrous Metals (Presses à Filer et Laminoirs à Chaud pour le Travail des Métaux non ferreux) Pfann. *Revue Technique Luxembourgeoise,* Vol. 28, July-Aug. 1936, pages 80-84. Modern extruding processes for shapes, wires and tubes, and equipment for them are reviewed and rolling mills for light metal sheets described. The billets and bars used for these processes must come absolutely sound from casting if satisfactory products are to be obtained. Ha (4a)

A 7000-Hp. Direct-Current Motor for a Reversing Mill. J. S. Newton. *Electric Journal,* Vol. 33, Sept. 1936, pages 401-403. Design and construction features of a giant reversing mill motor are discussed. CBJ (4a)

An Automatic Bar Mill. M. M. McDonald & Robert Fellers. *Electric Journal,* Vol. 33, Sept. 1936, pages 390-394. Description of an automatic bar mill and its operation is aided by a schematic flow-sheet. Control equipment is fully described. CBJ (4a)

Manufacture of Cast Rolls (Gray Iron, Hard Castings, Steel Castings) (Ueber die Herstellung von Gusswalzen, Grauguss, Hartguss und Stahlguss) H. Jungbluth. *Technische Mitteilungen Krupp,* Vol. 4, Aug. 1936, pages 129-142. The characteristic differences of these 3 kinds of rolls are described. The hardness of hard castings is due to the content of cementite while in gray Fe a large part of the C has been precipitated as graphite. The various structural forms can be produced according to the following general rules: The graphite content increases with increasing C and Si for a given cooling velocity. The graphite content increases with decreasing cooling velocity for a given composition. The graphite content is reduced by accelerated cooling until eventually all graphite has disappeared and the Fe solidifies as white cast Fe. Rolls of cast steel are used almost exclusively in the U.S.A., very seldom in Europe. Types and compositions of rolls are described and methods of manufacture discussed. Application of the various types in rolling mills for definite processes is given in a table and the causes for fractures of rolls are discussed. 29 references. Ha (4a)

Bethlehem's 72-In. Sheet-Strip Mill. F. D. Egan. *Electrical World,* Vol. 106, Aug. 1, 1936, pages 28-31. Electrified mill featuring centralized control is described. CBJ (4a)

Electronic Timers for Flying Shears. G. A. Caldwell, *Electric Journal,* Vol. 33, Sept. 1936, page 407. Timing device is described. CBJ (4a)

Measuring Rolling-Mill Pressures. A. L. Bement. *Electric Journal,* Vol. 33, Sept. 1936, pages 404-406. A magnetic strain gage is applied to mill stands to inform the operator as to the exact pressures between the rolls. Maximum reduction can thus be obtained with safety. Knowledge of the pressures makes possible the following: to have the pressure on both screws the same provided the steel entering the mill is uniform, to detect differences in thickness between the 2 sides of material entering the mill, to detect uneven roll cooling in hot mills which would result in loss of gage accuracy, to determine the proper division of load between stands of tandem mills for economical operation, and to determine and maintain the proper rolling pressure for materials subject to punishment by excessive rolling. CBJ (4a)

■ 4b. Forging & Extruding ■

A. W. DEMMLER, SECTION EDITOR

Forging and Heat Treating Locomotive Parts. J. B. Nealey. *Industrial Gas,* Vol. 15, July 1936, pages 15-17. See *Metals & Alloys,* Vol. 7, July 1936, page MA 344R/9. Ha (4b)

Forging the Light Alloys. J. Towns Robinson. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 87-91. Deals with the forging and stamping of the well-known light alloys such as Duralumin, "Y"-alloy and the Hiduminium R. R. series. It is advantageous to start with sound homogeneous ingots having a small and uniform crystal distribution. To do so not only makes possible easier working of the metal but also produces better ultimate results. The advantage of this type of structure over coarser columnar or a mixture of columnar and coarse equiaxed crystals is indicated. The author recommends a close inspection of ingots for defects. Round ingots are superior where the product is produced chiefly by compression and square ingots are used to better advantage when the material is to be elongated, reduced in cross-section and for stamping. Critical factors are (1) close control of soaking temperature, (2) procedure of the forging operation, and (3) shape and size of the dummy. Some precautions to be observed in stamping are indicated and the importance of recrystallization of extruded material is discussed. HBG (4b)

The Extrusion of Non-Ferrous Metals. A. Wragg. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 73-77. Author considers the recently developed extrusion process simply as a source of raw material. He discusses the products of this process as (1) rods, tubes and shapes for engineering purposes, (2) hot stamping stock, and (3) shapes and special sections. The 2 commonly used methods of extrusion are described, compared and the advantages of each are indicated. The design of the British type of press is compared with some types used on the Continent. Limits of size and shape of extruded material and the physical properties of a number of extruded alloys are discussed. The author gives as the 2 main limiting factors (a) that there must be no appreciable re-entrant angles which will require a tongue in the die, and (b) that the cross-section must be such that the flow of metal coming through the die is uniform along the section. HBG (4b)

Influence of Teeming Conditions on Forgeability of Chromium-Nickel Structural Steels. A. M. Pelevich & B. Kh. Sapir. *Kachestvennaia Stal,* Vol. 4, No. 5, 1936, pages 52-55. In Russian. A study of 133 heats of 0.15-0.22% C, 0.40 Si, 0.20-0.50 Mn, 0.8-1.2 W, 1.3-1.7 Cr, 4.0-4.7 Ni showed that exceptionally high losses due to ingots falling apart in forging were associated with teeming temperature and teeming time. The higher the temperature of the metal the slower must be the teeming which can be adjusted by varying the diameter of nozzles used. (4b)

■ 4c. Cold Working, including Shearing, Punching, Drawing & Stamping ■

The Deep Drawing of Sheet Metal. J. D. Jevons. *Metal Industry,* London, Vol. 48, Jan. 17, 1936, pages 67-72. Author states that during 1935 a study was begun of the fundamental principles of the process of deep drawing. He stresses the necessity for correlation of theory with practice and the need for a more practical, simple method of testing. He suggests as 4 principle fields for immediate study: (1) the fundamental principles underlying the behavior of plastic materials, (2) the interpretation and influence of "average grain size," (3) the causes of troubles experienced by the consumer, and (4) the elimination, by the producer, of those defects in his product which occasion most trouble to the consumer. The author believes that the importance of regularity in crystal size is underestimated. Only minor improvements in the manufacture of sheet were noted during the past year. Some of these are mentioned. Defects inherent in brass and sheet steel are considered. There are also mentioned as improvements of the past year that are wholly relevant to deep drawing, Cr-plating, food materials, the use of octagonal blanks, a better selection of lubricants, the elimination of inter-stage annealing and the deep drawing of plated sheet. HBG (4c)

Recent Developments in Steel Wire Technology. S. A. Braley. *Wire & Wire Products,* Vol. 11, July 1936, pages 323-325, 350-351. Fundamentals required for satisfactory production of steel wires with respect to chemical composition, crystal structure, physical properties and surface condition are discussed and proper coordination of research and plant is emphasized. Ha (4c)

New Researches on the Drawing of Cylindrical Shells. G. Sachs. *Journal Royal Aeronautical Society,* Vol. 39, Nov. 1935, pages 1081-1091; discussion, page 1092. The last decade has witnessed a great increase in the reduction obtainable in a single draw in deep-drawing operations. The results of several workers in this field are critically examined and correlated under the headings: drawing without and with sheet-weakening, tool form and drawing capacity, blank holder and drawing capacity, testing of sheet ductility, and the outlook for the future. 39 references. See also *Metals & Alloys,* Vol. 7, May 1936, page MA 232R/7. FPP (4c)

The Effect of Annealing on the Length of Cold-Drawn Rods. Kisuke Saito. *Science Reports Tohoku Imperial University,* Vol. 25, Apr. 1936, pages 128-140. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 401L/9. BWG (4c)

Influence of Cold Drawing on Mechanical Properties and Internal Strains of Chromium-Silicon Steel. G. I. POGODIN. *Kachestvennaia Stal,* Vol. 4, No. 5, 1936, pages 41-46. In Russian. The steel under investigation contained 0.89% C, 1.13 Cr, 1.43 Si and was used as tool steel occupying an intermediate position between C tool steel and high speed. Hot rolled 10.9 mm. rods were properly annealed and then drawn to different extents through dies having the same reduction angle. A comprehensive investigation showed that hardness of samples increases towards the center. Low reduction gives a proportionally greater hardening. Tensile stresses are present at the outside of rods, compressive near the center. The maximum stress is present 0.50-0.75 mm. under the surface. Distribution law of strains in samples having different reduction is about the same, but absolute values vary. Mechanical strength is closely related to the changes of hardness across the cross-section of specimens. Toughness is inversely proportional to mechanical strength. (4c)

Coldworking of Ageable Aluminum Alloys (Spanlose Formgebung von aushärtbaren Aluminiumlegierungen) H. HORNAUER. *Werkstatt und Betrieb,* Vol. 69, May 1936, page 121. Survey of the different types of alloys, influence of temperature on tensile strength and workability. The forming of a C-shape from sheet by pressing, bending or drawing is illustrated. Sources of failures are discussed. HR (4c)

Deep Drawing Capacity of Pure Aluminum Sheets of Different Degrees of Hardness (Die Tiefziehfähigkeit von Reinaluminium-Blechen verschiedenen Härtegrades) WERNER HELLING. *Metallwirtschaft,* Vol. 15, Apr. 24, 1936, pages 388-394; May 1, 1936, pages 409-412. The deep-drawing capacity, evaluated by the ratio of the diameter of the form to that of the die, was determined for a large number of commercial pure Al sheets in the fully annealed, ¼, ½, ¾ and fully hardened state. It was shown that this could be predicted by the Erichsen value only when the tensile strength is also known. The power consumption increased, but only at the beginning of the draw, with increasing hardness of the starting material. The elasticity of the walls increased with the amount of rolling of the sheet, while the weight loss by polishing, and time required for polishing decreased. GD (4c)

Broaching Lead Composition Cylinders. ROGERS FISKE. *Iron Age,* Vol. 138, Aug. 13, 1936, pages 44-45. Describes method employed by the Goss Printing Press Co. in broaching printing press plates of cast metal containing about 80% Pb. Broaching operation consisted of cleaning inside of plate and at the same time giving a true and clean curface to the lugs. VSP (4c)

Cold Pressing and Drawing—the Metallurgical Aspect. C. H. DESCH. *Journal Royal Aeronautical Society,* Vol. 39, Nov. 1935, pages 1077-1080; discussion, page 1092. Cold pressing is applicable only to the more ductile metals, usually in the form of thin sheets. The metals must each possess sufficient ductility, absence of marked directional properties, uniform (usually small) grain size and, if possible, uniform texture throughout the thickness. Very fine grained materials behave, because of the general averaging of orientation differences, as if sensibly isotropic, while large grained materials may develop "orange peel" surfaces when deformed by pressing in a die. Fine grained materials, however represent some sacrifice in ductility, hence a compromise must be effected. The desired grain size and texture may be obtained by cold rolling followed by annealing or by normalizing only. Oxidation of the surface, either during annealing, normalizing or pickling must be avoided. Among the materials other than soft steel that can successfully be drawn and cold pressed are ductile stainless steels, Al and duralumin. FPP (4c)

Flow of Material in Cold Drawn Hollow Ware (Über Werkstoffwanderung bei der Herstellung kaltgezogener Hohlkörper aus ebenen Platten) H. MEYER AUF DER HEYDE. *Werkstatt und Betrieb,* Vol. 69, May 1936, page 132. After a short discussion of the different metals used in deep drawing, formulas for the flow of material are developed, results given in 7 tables. Practical examples show usefulness of formulas. HR (4c)

■ 4d. Machining ■

H. W. GRAHAM, SECTION EDITOR

Profiles for Propellers. GEORGE M. GILLEN. *Welding Journal,* N. Y., Vol. 15, June 1936, pages 9-10. Description of machine for automatically (machine) cutting propeller profile from forging. WB (4d)

Metal Turning for Instrument Makers. A. S. NEWMAN & R. S. CLAY. *Journal of Scientific Instruments,* Vol. 13, Apr. 1936, pages 109-114. A discussion of turning tools, tool holders and some of the kinks to be observed in getting good results. RAW (4d)

Tooling Chrysler Axle Shafts for Low-Cost Production. FRANK J. OLIVER. *Iron Age,* Vol. 138, July 9, 1936, pages 34-39. Describes the up-to-date installation of machining and heat treating equipment for machining rear axles at the plant of Chrysler Corporation. Material from which rear axle shafts are made is a special Chrysler Mo steel containing 0.60-0.65% C. Shaft reaches machine line rough forged to shape and in normalized condition. Gives details of machining operation and subsequent treatment. VSP (4d)

Rapid Grinding Technique for New and Damaged Carbide Tools Demonstrated. *Steel,* Vol. 98, June 1, 1936, pages 46, 48. Time for grinding carbide tools can be reduced greatly by shaping a crown about $\frac{1}{16}''$ high on grinding-wheel for roughing and semifinishing operations; maintenance of constant tool motion while grinding; use of an angle 4° greater than finished angle desired, when rough grinding, and finish grinding at desired angle, grinding on carbide tip only; and alternate grinding on carbide tip and steel shank when necessary to hog off large amounts of stock, as in case of chipped tools. MS (4d)

Cemented-carbide Tools in Present American Shop Practice. R. D. PROSSER. *Metal Treatment,* Vol. 2, Summer 1936, pages 93, 106. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 118R/10. JCC (4d)

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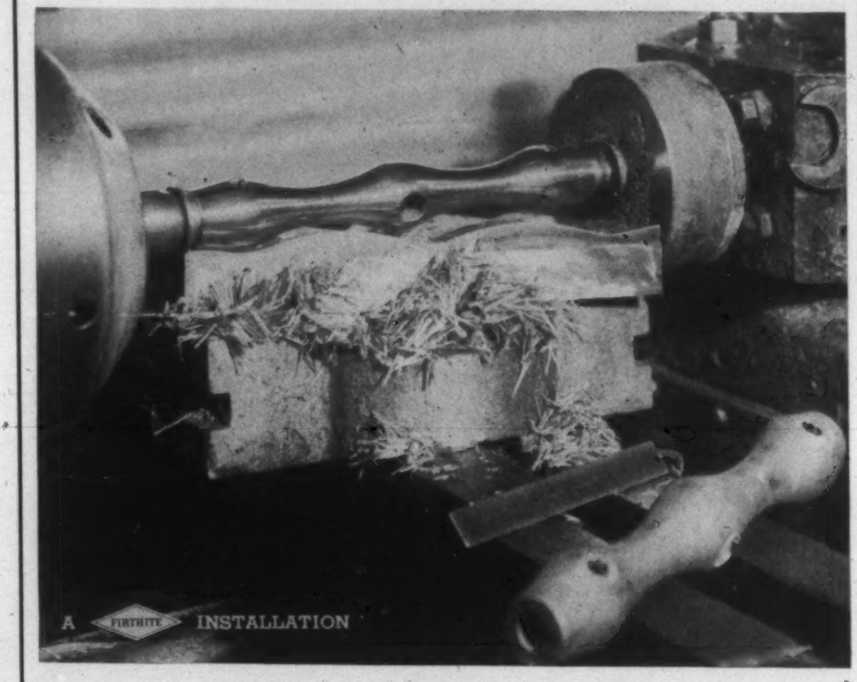

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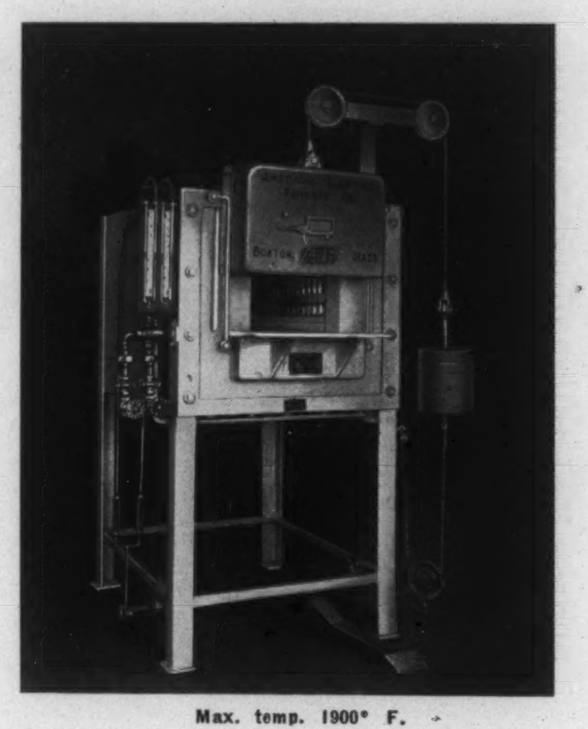

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5. HEAT TREATMENT

O. E. HARDER, SECTION EDITOR

Metallurgy of Transmission Gears. R. B. SCHENCK. *S. A. E. Journal*, Vol. 38, June 1936, pages 13-19. Gear failures are of 2 types, wear and breakage. Wear occurs as pitting of gear face due to fatigue under compressive stresses, and is progressive. Another form of wear is scoring where the surface flows due to improper design, poor contact, low surface hardness or excessive loading. Breakage of teeth is due to either low impact or fatigue, the former from improper heat treatment, the latter because of incorrect design, poor contact, low tooth strength, excessive overloading, or by notch effects, due to undercuts, roughness, or scratches at base of tooth. High C steels represent about 90% of total gear production according to recent survey of 20 passenger car manufacturers. Disagreement exists at present on relative merits of electric and O. H. steels. Low C steels are 6-8 grain size and high C of 4-6, 5-7 with 6-8 in general use. Large gears are forged in upsetter or under hammer, smaller gears sometimes machined from bar stock. Die design and macro-etch important for producing smooth flow in forging operation. Old style, manually-operated forge furnace is still being used. Annealing produces structures most suitable for machining and hardening, and is usually carried out in continuous, automatically regulated furnaces, permitting better control of cycle than in old batch type furnace. Low C steels are furnace or air cooled through lower critical from about 1750° F.; S A E 2515 requires slow cooling because of air-hardening tendency. Some plants air cool and others slow cool SAE 4615 and 4620. High C steels are slow cooled through lower critical from 1550° to 1750° F. Lamellar pearlite is aim of anneal. Mo steels do not form lamellar pearlite but have optimum structure of their own. More than small amounts of sorbite or spheroidal cementite give machining troubles. Fine grain must be cooled through Ar_1 more slowly than coarse grain to develop same amount of pearlite. Duplexed and banded structure are discussed and hardening of gears by pack carburizing reviewed. Low C gears are hardened directly from carburizing box at 1700° F. or 100° F. or more below hardening temperature, and where distortion is a factor gears are cooled in box and cyanide reheated to 1400°-1500° F. for hardening. Cyanide hardening procedure and equipment are detailed for continuous process. Drawing of gears ranges from 300°-500° F. in continuous salt baths, forced draft electric furnaces or gas fired continuous furnaces with automatic control. Low C gears have heavy case, soft core and high C, the opposite; the low C having case of .03"-.05", Rockwell C 55 to 62 and core of Rc 30-40. Rule used is "twice as much core as case" for which the aim is case depth of 1/6th tooth thickness at bottom of tooth. High C gears have case .001" to .010", Rc 48-58; core hardness Rc 45-55. Suggested rule for high C is .001" of cyanide case for each point of core hardness below Rc 55. Discussion is given of the relation of case to core for prevention of gear failure by wear, fatigue and impact. Present metallurgical practice at Buick plant is discussed in succeeding pages. The steel is O. H. product identical with SAE 3145 except for C range of .43-.48. Specifications cover chemistry, grain size, normality, banding, inclusions and macro-structure. Grain size 6-8 specified, duplex structure avoided, inclusions are rated according to a number scale. Macrostructure is examined with specimen of bar upset at 2350° F. to ¼ original length which parallels macro of forged gear. Present dispute as to merits of open and dense macro is mentioned as inconclusive. Forging is done on latest design forging machines and material annealed in under-fired continuous, automatically controlled furnaces with 4 separate zones to reduce annealing time and banding. Maximum amount of lamellar pearlite is aim and macro is compared in text with partially divorced and spheroidized structure. Cyanide hardening is practiced in conveyor system procedure including preheat, 4 cyanide pots, quench, wash and rinse to give average case of about .002". Drawing at 450° F. takes place in 2 hr. cycle in continuous furnace. Case ranges from .001" to .003" with Rc of 50-55, core hardness Rc 50-55 (light case has no effect on Rc). For high C gears an improved method is used for hardening in controlled atmosphere muffle furnace for which conditioned gas is used to produce case averaging .006". Case is of excellent quality, slightly hyper-eutectoid and spheroided excess cementite. After passing through muffle the gears are dropped into quenching tank under furnace. Drawing at 450° is next step. 2 Rc points of hardness increase are found for new process over cyanide hardened gears and distortion is less. WB (5)

The Importance of the Human Element in Heat Treating of Steel. L. WILLIAMSON. *Industrial Heating*, Vol. 3, Sept. 1936, pages 568-572. It is emphasized that in spite of all improvements and automatic devices for the operation of heat treating furnaces, skill, judgment and thought of the heat treater are still necessary and that the human factor must not be neglected in order to produce the best steel qualities. Ha (5)

Prevention of Oxidation and Decarburization of Steel. A. G. ROBIETTE. *Metal Treatment*, Vol. 2, Summer 1936, pages 77-84. Reviews the gas-metal reactions occuring between steel and annealing atmospheres during heat-treatment in controlled atmospheres. Excess water vapor, though reducing in action at the annealing temperature, will cause oxidation during cooling. Problems discussed include the production of water vapor by the water-gas reaction when combusted gases are used for bright annealing; the possibilities of descaling by means of a reducing atmosphere, decarburization, carburization; the influence of alloying elements on the behavior of special steels. Rich atmospheres made by partially burning coal gas are cheap and can now be used since methods for removing organic S have been developed. Typical furnaces are reviewed and some industrial applications outlined. JCC (5)

Influence of Isothermic Treatment on Mechanical Properties of Chromium-Nickel Steels (Contribution à l'étude de l'influence du traitement isothérmic sur les propriétés mécaniques des aciers chrome-nickel) J. E. KONTOROVITCH. *Revue de Métallurgie*, Vol. 33, July 1936, pages 460-465. 4 steels with 0.14-0.39% C, 0.8-1.8 Cr, 2.2-3.6 Ni were investigated. Properties obtained by isothermic transformation and usual quenching and drawing were practically the same. JDG (5)

Heat Treatment of Cast Iron. A. A. TIMMINS. *Foundry Trade Journal*, Vol. 54, May 28, 1936, pages 421-423. See *Metals & Alloys*, Vol. 7, June 1936, page MA 289L/1. AIK (5)

5a. Annealing

Stress-Relief Annealing High-Strength Monel Metal Plate. PETER R. KOSTING. *Preprint meeting American Society for Testing Material,* June 1936, 9 pages. The effect of temperature of annealing and time at temperature upon the physical properties of 4 heats of high-strength Monel metal plate, ½″ thick, was studied. Particular attention was paid to yield strength, 0.00% set, extensometers of 0.0002″ and 0.00002″ sensitivity being used. In the range 550° to 600° C. the maximum increase in yield strength, 0.00% set, is obtained no matter whether the plate were slightly cold rolled or hot rolled but finished at a low temperature during manufacture. Annealing first increases and then decreases the yield strength at higher per cent sets. The temperature at which maximum values are obtained is governed by the amount of cold working to which the metal was subjected. The tensile strength reached at 450° C. is slightly higher than that at 550° or 600° C. Yield strengths, 0.2 and 0.05% set, pass through slow maxima at 450° C. in 2 to 3 hrs. and sharper maxima at 550° C. At 600° C. yield strength of 0.05% set is unaffected but of 0.2% set is lowered. The extent of increase of yield strength 0.00% set, is dependent upon the temperature and time at temperature. An increase of 11,000 lbs./in.^{2} was noted after 3 to 4 hrs. at 450° C., but the maximum increase noted of 15,000 lbs./in.^{2} was reached in about 1 hr. at 550° C. and in less than 1 hr. at 600° C. If held longer at 550° C. there is no falling off of yield strength but at 600° C. there is a very slight falling off. The yield strength, 0.00% set, is sensitive to the presence of internal stresses. When the maximum increase in this yield strength was obtained it was judged that the internal stresses had been removed, if not completely, then sufficiently for practical purposes. Heating to 575° C. and holding for 3 hrs. and furnace cooling is a suitable treatment for stress-relief annealing this high-strength monel metal plate.
VVK (5a)

5b. Hardening, Quenching & Drawing

Change of Hardness in Quenched Carbon Steels by Tempering. RIMPEI KIKUCHI. *Kinzoku no Kenkyu,* Vol. 13, Aug. 1936, pages 333, 341. In Japanese. Author considered the mechanism of tempering of quenched C steels as follows: On tempering quenched steel its hardness increases at first and then decreases. This change of property takes place by the following 3 processes; (1) the transformation of α martensite into β martensite (hardening), (2) the separation of cementite from β martensite (softening), (3) the change of residual austenite into martensite (hardening). These processes take place very slowly when the temperature is not sufficiently high, since the diffusion velocity in solid solution is very small. The author proved his theory by measuring hardness of quenched C steel (0.85% C), tempered for a prolonged period, and the following results were obtained; (1) on tempering up to 95°, α martensite changes into β martensite, (2) by tempering above 100° the decomposition of β martensite takes place, and (3) between 100° and 150° the change of residual austenite into martensite is completed.
KT (5b)

Tempering High Speed Steels. I. Z. YASNOGORODSKI. *Kachestvennaia Stal,* Vol. 4, No. 4, 1936, pages 29-36. In Russian. Steels containing 0.72 C, 4.20 Cr, 17.20 W, 1.08 V; 0.69 C, 4.35 Cr, 11.25 W, 2.04 V; 0.62 C, 2.97 Cr, 17.70 W, 0.72 V, 6.50 Co were quenched between 1200° and 1300° C. and tempered for different length of time between 200° and 650° C. Properties produced were studied for hardness at room and elevated temperatures, magnetic characteristics (apparatus for testing is described) and cutting properties. Continuous and intermittent tempering was tried. Optimum drawing temperatures for these steels are located between 500° and 550° C. Higher drawing temperature under identical conditions leads to faster martensite decomposition lowering hardness and stability of the metal. Intermittent tempering leads to more rapid austenite decomposition which is practically complete after 3-5 treatments. Hardness of high speed steel and its cutting qualities increase with increased amount of decomposed austenite. This recommends intermittent tempering. (5b)

Use of Chromium-Manganese-Molybdenum Steel for Castings. Z. I. KOPELMAN & T. V. SERGIEVSKAIA. *Kachestvennaia Stal,* Vol. 4, No. 4, 1936, pages 50-53. In Russian. By normalizing and oil quenching castings made of steel containing 0.32-0.40 C, 0.25-0.50 Si, 1.40-1.60 Mn, 0.6-0.8 Cr, 0.50 max. Ni, 0.35-0.45% Mo it was possible to produce in medium size casting the following physical properties: 63 kg./mm.^{2} elastic limit, 78 kg./mm.^{2} tensile strength, 18% elongation and 7.7 kg.m./cm.^{2} impact strength. Castings did not warp or crack. A number of heats were made and cast with satisfactory results after heat treatment. Detailed information regarding heat treating practice is given. (5b)

Hardening of High-Speed Steel. MASUHIRO SUZUKI & SIGEO OWAKU. *Kinzoku no Kenkyu,* Vol. 13, June 1936, pages 223-260. In Japanese. Authors investigated the cutting efficiency of ordinary high-speed steel, which contains about 18% W, 4% Cr and 0.8% C, and the so-called super-high-speed steel which contains Co besides the above constituents. The cutting efficiency of high-speed steel tools depends upon the heat treatment as well as upon the constituents. The heat treatment studied by the authors includes the hardening temperature, the length of time at that temperature, the properties of cooling liquids, the tempering temperature, the time of tempering and the structure of steels. The result is as follows: the high-Co high-speed steel which contains more than 10% Co is the best; the quenching temperature is 1300° C; the time of heating is 2 minutes for a specimen of 10 x 10 x 50 mm.; severe quenching is not recommended; the tempering temperature is 600° and the time 20-60 minutes. The high-speed tools obtained in this way have a hardness of Rockwell C 68 and can easily cut, plane or drill water-toughened high Mn steel. KT (5b)

Historical Data Relating to Hot-galvanizing Practice for Wire. J. L. SCHUELER. *Wire & Wire Products,* Vol. 11, Aug. 1936, pages 383-385, 403. A history of the hot-galvanizing process is given and the progress and improvements in the latter process during the last 15 years, in particular the galvannealing process, the Crapo process, and the flame sealed process, are described. Ha (5b)

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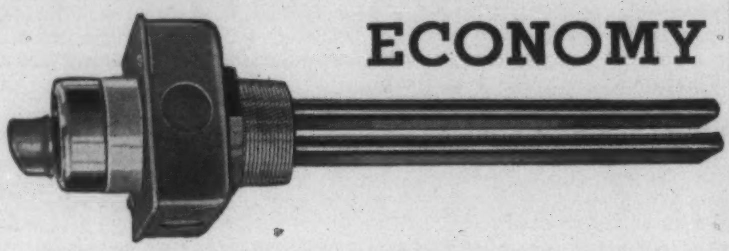

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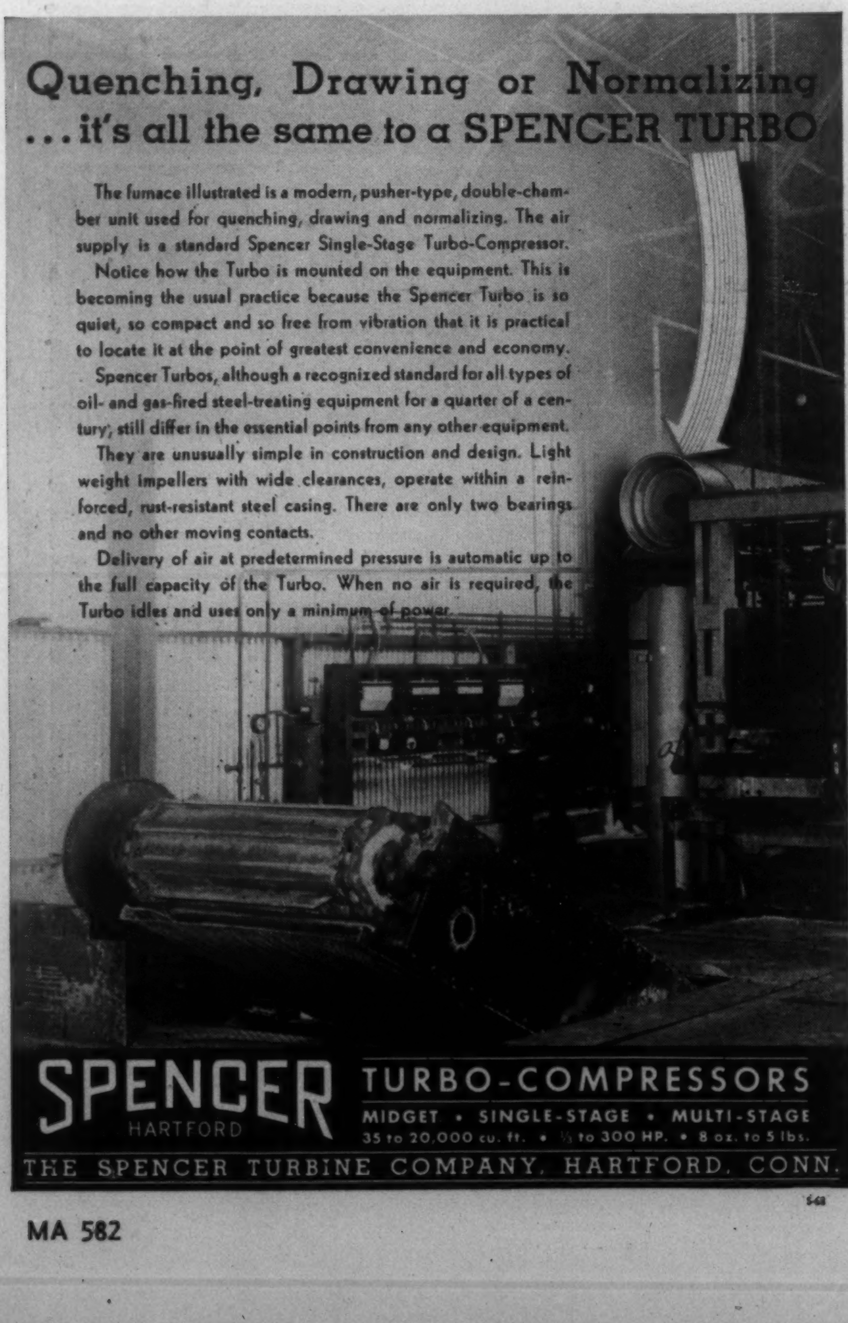

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Thermal Treatment of Steel with a Minimum Warpage. V. V. CHERNISHEV. *Kachestvennaia Stal,* Vol 4, No. 3, 1936, pages 30-34. In Russian. 3 steels were investigated having a composition of: 0.28% C, 0.95 Cr, 3.00 Ni, 0.31 Si, 0.36 Mn; 0.36 C, 1.55 Cr, 3.43 Ni, 0.38 Si, 0.65 Mn; 0.34 C, 1.58 Cr, 4.30 Ni, 0.24 Si, 0.52 Mn. Determinations were conducted on round test bar specimens, warpage being obtained as displacement from the true axis of these specimens. Interrupted quenching gave the least warpage. The best results were obtained by heating steels to their austenitic range for 20 minutes at temperatures corresponding to great stability of supercooled austenite (525° C. for the first steel and 500° C. for two remaining) and then heating them for 1 hour at 325° C. for the first and 300° C. for the remaining two. Producing the desired physical properties, this treatment practically eliminates warping. (5b)

■ 5c. Aging ■

Cyanidation of Cutting Tools. V. YA. DUBOVOI. *Kachestvennaia Stal,* Vol. 4, No. 6, 1936, pages 46-50. In Russian. Shop experiments showed that useful life of cyanided drills, threading milling cutters, broaches and shaped cutters was about 3 times as high as of those which were not so treated. Shaper tools were, however, inferior to the untreated. All tools were made of standard high speed steel and were cyanided after final heat treating and grinding. Cyaniding was conducted at 565°-575° C. in 96-98% NaCN. No definite dimensional changes were observed after cyaniding, but a further study is necessary. Time of cyaniding depends on the mass of the samples, and on the desired depth of case. Cooling can be conducted in air. Treating for 10-20 minutes seems to be the best for medium size drills. (5c)

Age-Hardening Mechanism in Ag-Al Alloys. MASAHIDE KOSAKI. *Kinzoku no Kenkyu,* Vol. 13, Aug. 1936, pages 342-348. In Japanese. In order to investigate the mechanism of age-hardening in Ag-Al alloy, a study was made with an alloy containing 40% Ag quenched from 550° C. in water, after being heated at that temperature for 30 minutes, followed by aging at room temperature for 20 days and tempering for 6 hours at 60°, 100°, 150°, etc., respectively, and then cooling slowly in the furnace. The variation in lattice constant, density and hardness of the specimen due to the above heat-treatments was measured; dilatation and electric resistance curves of the quenched specimen during a slow heating were also taken. The result of measurements led to the following conclusion; in the course of aging the hardness attains a maximum value at the instant prior to the separation of crystallites, while it decreases after their separation. This result is in agreement with the so-called solid solution theory on age-hardening phenomenon. KT (5c)

■ 5e. Carburizing ■

Cementation of Steel by Gases Produced by Pyrolysis of Oil Products. N. A. MINKEVICH, S. K. IL'INSKI & V. N. PROSVIRIN. *Kachestvennaia Stal,* Vol. 4, No. 2, 1936, pages 31-43. In Russian. Comprehensive investigation of carburizing produced with gases obtained by cracking kerosene and some oils. The liquid was vaporized and then passed through a tube furnace heated to 700°-850° C. Gases so produced were used for laboratory and commercial scale experiments. For the same depth of carburization the use of these gases produces the results 2-2.5 times cheaper than box carburizing with solid compound. (5e)

Carburizing Steel With Charcoal Generator Gases. M. G. PYATIGORSKI. *Kachestvennaia Stal,* Vol. 4, No. 4, 1936, pages 43-49. In Russian. Laboratory gas generator was developed in which gases were obtained by combined action of air stream on charcoal and kerosene which was introduced in the apparatus drop by drop. The device is described. Carburization with gases so produced yielded entirely satisfactory results. (5e)

Steels in Truck Production. A. G. VLADIMIROV. *Kachestvennaia Stal,* Vol. 4, No. 5, 1936, pages 22-24. In Russian. In order to reduce Ni consumption Cr-Mn-Mo steels were investigated as material for truck gears. With steels containing 0.2% C, 0.9 Mn, 1.0 Cr and 0.3 Mo after cementation at 900° C., quenchings at 850° and 800° C. in oil and drawing at 200° C. it was possible to obtain 70-72 kg./mm.^{2} yield point, 102-106 kg./mm.^{2} tensile strength, 17-19% elongation, 44% reduction in area and 10 kg. m./cm.^{2} impact strength. Structure of carburized layer is the same as in Cr-Ni steels. (5e)

Carburization of Basic Electric Steel from Masa Magnetic Sand. TOYOZO ISHIGAKI. *Suiyokwai-Shi,* Vol. 9, July 1936, pages 57-71. The author carburized the basic electric steel from Masa magnetic sand in a mixture consisting of charcoal powder and $BaCO_3$, and after confirming the existence of a close relation between the occurrence of the abnormal structure of the carburized steel and the O content in the uncarburized steel, he carburized electrolytic Fe in the above mentioned carburizing mixture. It was found that the abnormal structure begins to appear in the pure Fe when its O content exceeds about 0.052%. He concludes that the abnormal structure never arises from carburizing because the O content of the basic electric furnace steel from the Masa magnetic sand is always far below the limit of the occurrence of the abnormal structure, namely below 0.015%. HN (5e)

New Method for Surface Hardening Austenitic Steels (Les nouveaux procédés de durcissement superficiel des aciers austenitiques) E. VALENTA & V. KOSELEV. *Revue de Métallurgie,* Vol. 33, July 1936, pages 466-472. In order that a Hadfield steel may remain austenitic its C content should be sufficiently high. When Mn is kept the same but C is reduced martensite is formed. C reduction on the surface can be achieved by decarburization in a slightly oxidizing atmosphere. The depth of martensitic layer so produced is inversely proportional to Mn content. The best composition is 7% Mn and 0.7% C. Decarburization can be efficiently conducted in N_2 containing about 2% O_2 at 1000°-1080° C. Lower temperatures than these increase the reaction time; at higher temperatures coarse crystallization begins. Average decarburization under these conditions is 0.067 mm./hr. In the very outside layers C removal goes too far so that martensitic case begins slightly farther in. JDG (5e)

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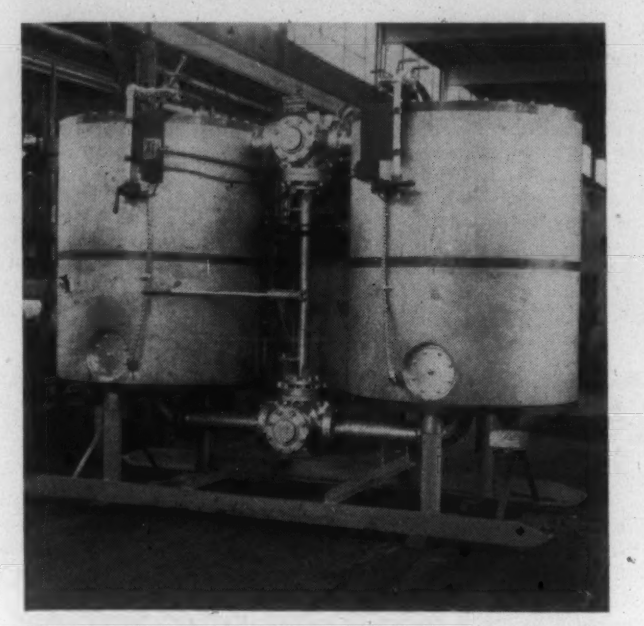

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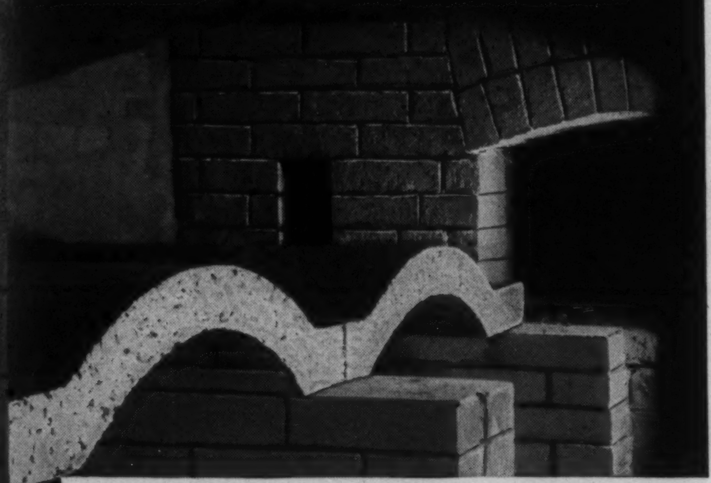

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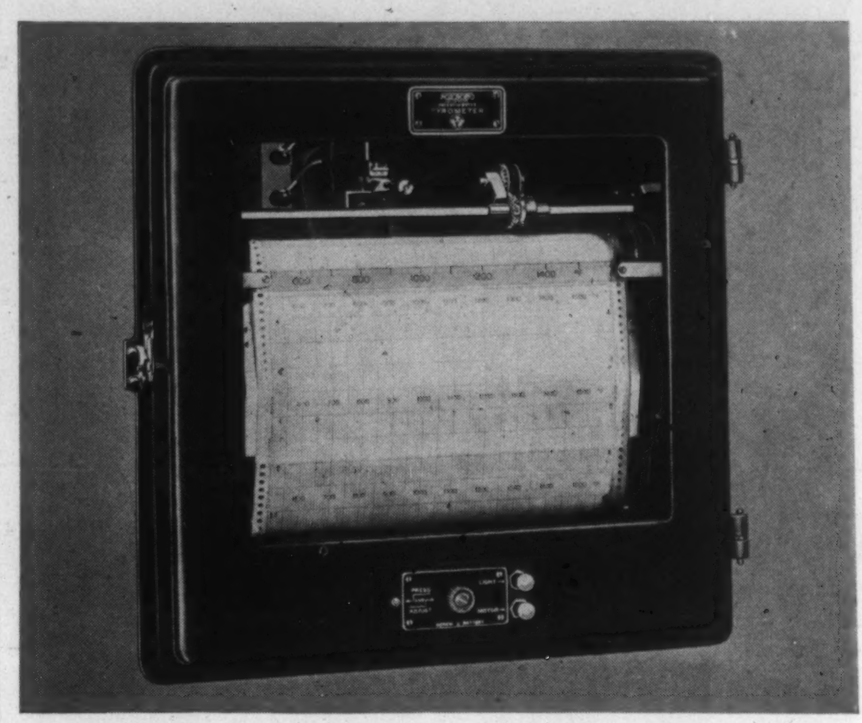

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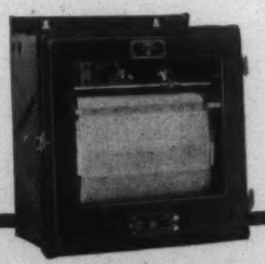

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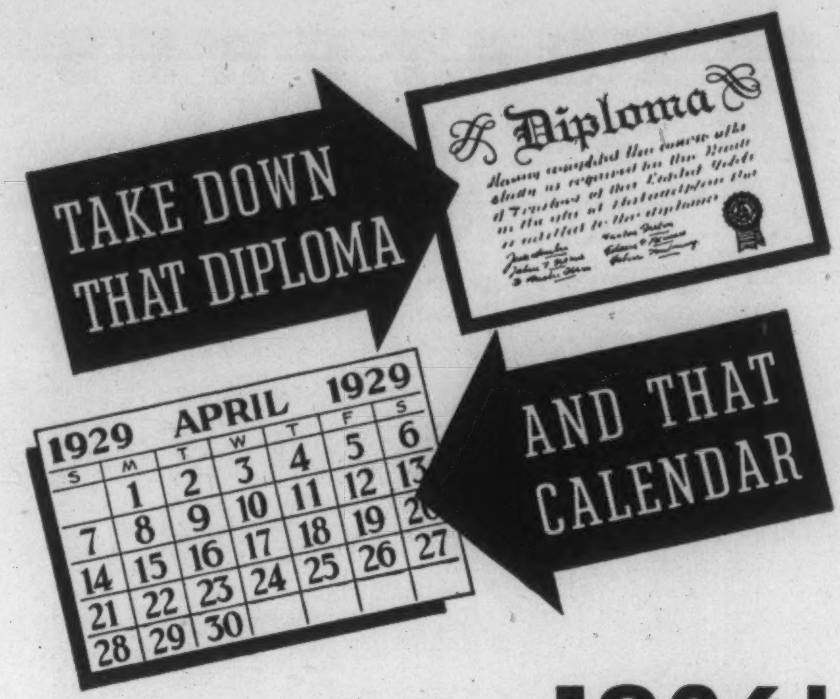

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6. FURNACES, REFRACTORIES AND FUELS

M. H. MAWHINNEY, SECTION EDITOR

Notes on Copper Refinery Furnace Firing and Refractories. H. C. ROBSON. *Bulletin Institution Mining & Metallurgy,* No. 373, Oct. 1935, 8 pages; No. 374, Nov. 1935, pages 1-15; No. 376, Jan. 1936, pages 25-29. Pulverized coal firing has the following advantages over grate firing: (1) Fuel costs are reduced 55%, (2) the sequence of the refining cycle is smoother (no interruptions for declinkering, etc.), (3) it is at all times under full control (as to temperature, oxidizing conditions, etc.), (4) during periods of inactivity coal fired can be cut instantaneously to the minimum, (5) the choice of coal is wide and even inferior grades can be used. A new burner is described. Repair costs were reduced 75% over 3 yrs. by replacement of ordinary refractories by large silica blocks, rubbed together to give a perfect joint, fettled after each charge with white quartz ground to —¼″ and mixed with 10% H_2O. A detachable sectionalized roof of superior design is shown; 10 advantages are listed. AHE (6)

Automatic Handling of Mill Length Shapes During Heat Treatment. E. J. JANITSKY. *Metal Progress,* Vol. 30, Oct. 1936, pages 55-58. Describes equipment for handling automatically mill lengths of a large variety of shapes and sizes from the heat treat furnace. The automatic handling drains the material from the quench and charges it in the draw furnace. WLC (6)

Controlled Furnace Atmospheres. E. O. MATTOCKS. *Metal Progress;* Vol. 30, Oct. 1936, pages 27-34, 46. Review of use and application of controlled atmospheres in heat treatment. 12 references. WLC (6)

Automatic Machines for Carburizing. J. B. NEALEY. *Metals & Alloys,* Vol. 7, Oct. 1936, pages 250-252. Description of continuous type pot carburizing furnaces and their hardening and tempering accessories. WLC (6)

Hardening Razor Blade Steel by a New Process. ALBERT R. STARGARDTER. *Metals & Alloys,* Vol. 7, Oct. 1, 1936, pages 253-256. Describes briefly use of inductive heating for treating razor blade steel in strip. The novel feature is a control arrangement not described in detail which controls the quality of the heated product of the furnace. The hardened strip passes through a magnetic test and the results of this magnetic test automatically adjust the furnace conditions to produce the desired structure in the steel. The magnetic properties have been associated with the structure of fine evenly distributed carbides which is desired. Micrographs show the structures of good and inferior hardening. WLC (6)

Refractories, Recent Types, Uses and Unit Costs. *Metal Progress,* Vol. 30, Oct. 1936, pages 59-63, 72. Review of refractory types and their application, properties and costs. WLC (6)

New Ideas in Furnaces. *Metal Progress,* Vol. 30, Oct. 1936, pages 64, 65, 69, 70. Review and discussion of 5 articles on furnace designs. WLC (6)

Insulation of Open-hearth Furnaces. E. ORCHARD. *Iron & Steel of Canada,* Vol. 19, Aug. 1936, pages 12-13. Method used by the Algoma Steel Corp. is described for furnace and checkers. Ha (6)

Vertical Furnaces for Hardening, for Tempering. F. E. HARRIS. *Metal Progress,* Vol. 30, Aug. 1936, pages 52-56. Describes design and operation of vertical furnaces for the heat treatment of automotive parts. WLC (6)

Pouring Pit Refractories and Their Effect on Alloy Steel Quality. E. E. CALLINAN. *Industrial Heating,* Vol. 3, June 1936, pages 383-386; Sept. 1936, pages 579-582; *Iron & Steel of Canada,* Vol. 19, Aug. 1936, pages 8-10. The effect which pouring refractories may have on the quality of alloy steels and the properties which they must possess to minimize chances of ruining heats of steel are discussed. Correct physical and chemical properties to resist molten slag and metal attack and high refractoriness are of prime importance, in particular in the ladle. Ladle bricks are at present usually made of siliceous clays, a typical composition being 66% SiO_2, 25% Al_2O_3, 4.5% Fe and Ti oxides, 0.4% CaO, remainder mainly Mg, Na and K oxides; max. firing temperature 2200° F. Materials used for nozzles, sleeves, hot tops, plugs and their shapes are described. Cooperation between steel producer and ceramic engineer for further improvement is advocated. Ha (6)

Swedish Steel Made in Electric Furnace. EINAR OEHMAN. *Metal Progress,* Vol. 30, Sept. 1936, pages 72-73. Statistics and history of electric furnace production of steel in Sweden are accompanied by reference to a new 2-frequency type of melting furnace being developed. In this furnace a high frequency coil induces the melting current in the charge and a low frequency coil produces vigorous stirring action with rapid refining action by emulsification of the slag with the steel. Both currents may be regulated at will. WLC (6)

Combustion Chamber Design for Industrial Furnaces. M. H. MAWHINNEY. *Industrial Heating,* Vol. 3, Sept. 1936, pages 563-566, 596. The points to be observed in the design of efficient combustion chambers with respect to temperature, dimensions and rate of heat liberation are discussed in detail. Ha (6)

Colloidal Fuel. A. B. MANNING & R. A. ACTON TAYLOR. *Industrial Chemist,* Vol. 12, Mar. 1936, pages 111-112. An abstract of a paper read before the institution of Chemical Engineers on Feb. 21, 1935. RAW (6)

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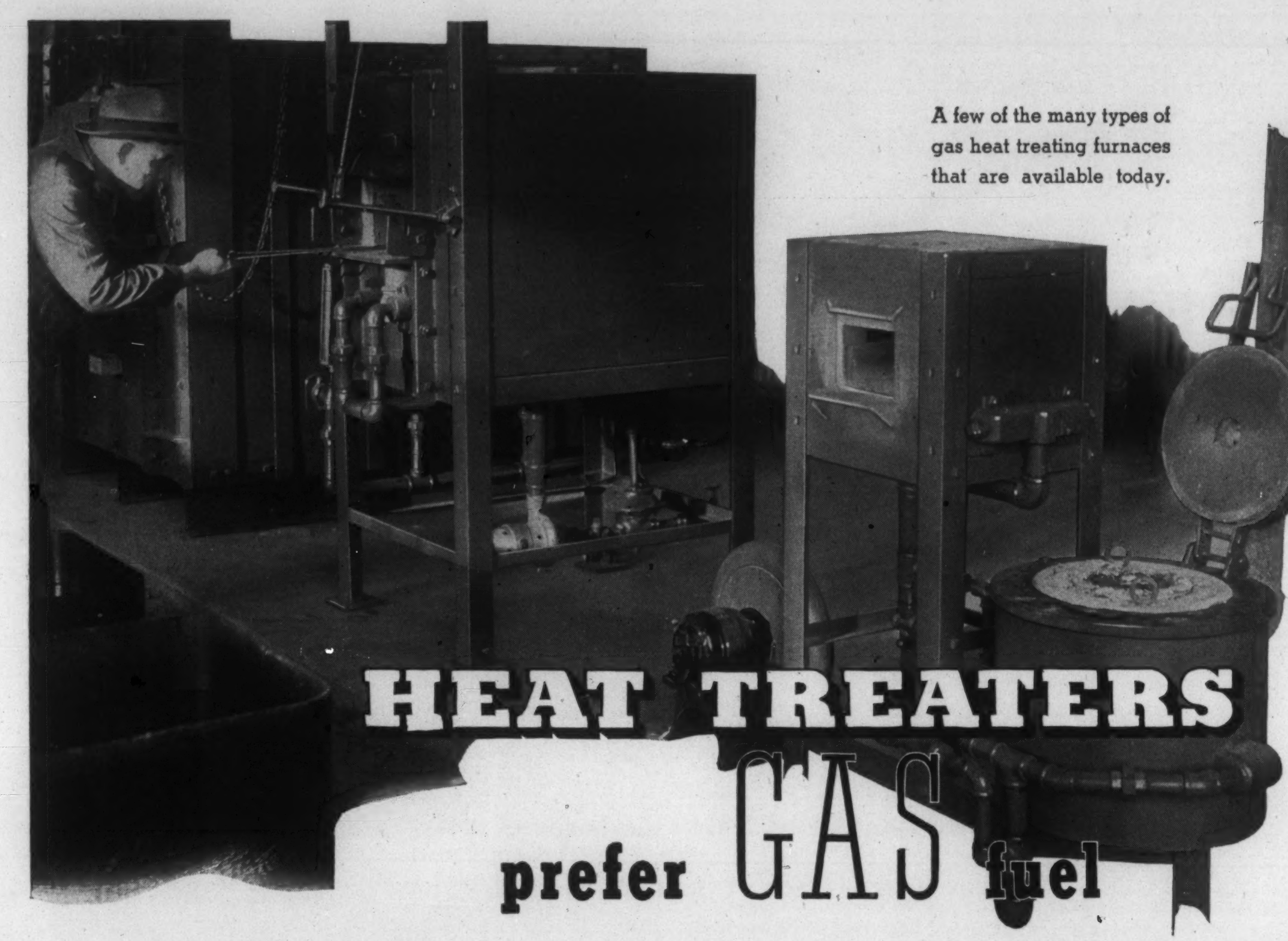
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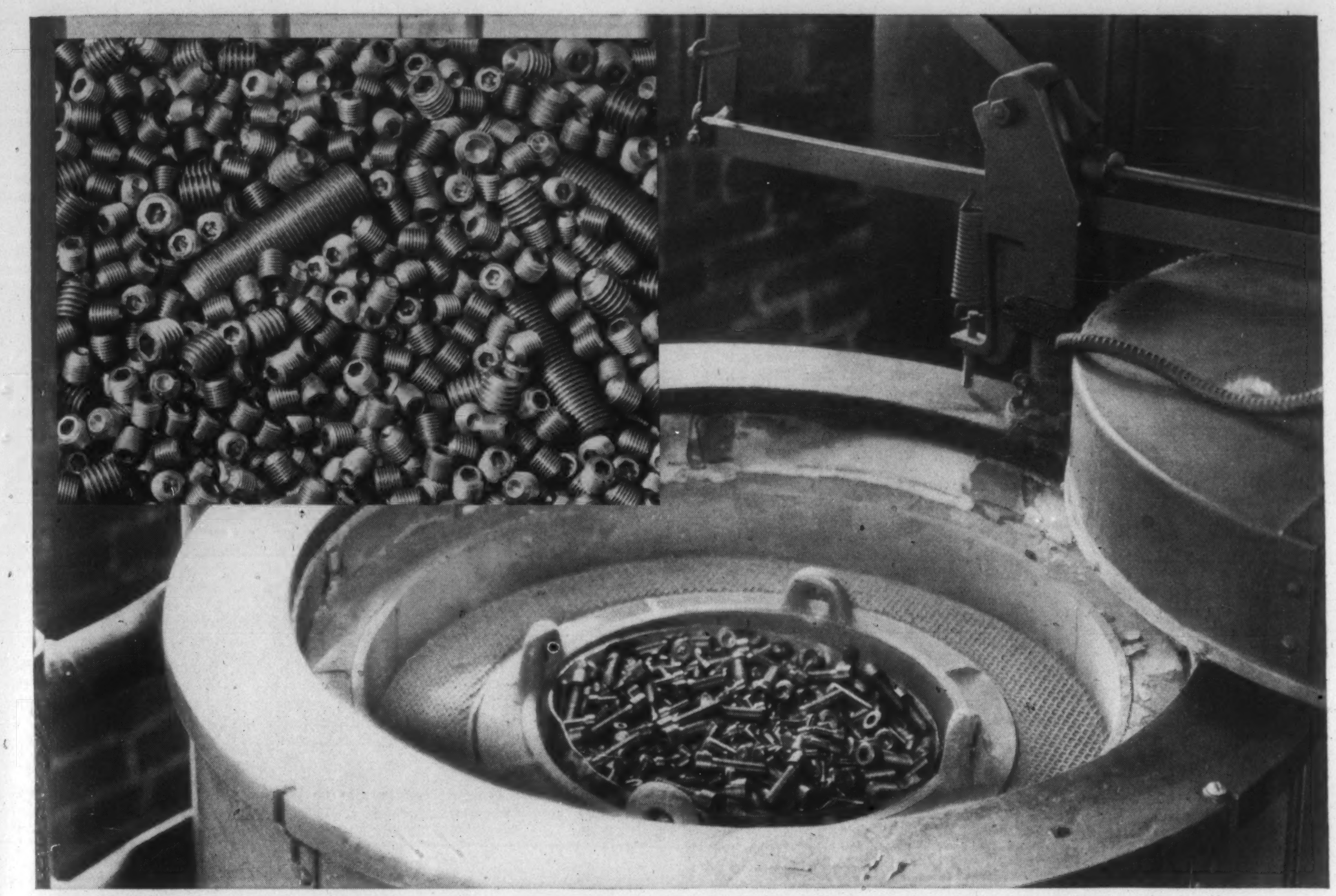

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7. JOINING

7b. Welding & Cutting

E. V. DAVID, SECTION EDITOR

The Effect of Welding on Design. T. McLean Jasper. *Welding Journal,* N. Y., Vol. 15, July 1936, pages 2-8. One advantage of welding in pressure vessel field is weight reduction of 25% with same safety as previous lap-riveted joints. Seamless, butt joints by welding are of advantage in many fields. In the past, quality of welding was lower than that of the steel, but now welding has surpassed steel quality and poor welding is often caused by poor steel. Advance in welding is due to production of better quality steels. Higher or equal physical properties for the weld over those of the plate are preferred. Tensile tests on welded joints are shown in curves and illustrations, indicating 16% higher tensile for weld than plate. A graph is given of pull test results on specimens cut parallel to weld, and including it showing gradual rise in tensile strength from 2⅝″ thick parent metal to the weld and steeper rise of proportional limit for the same sections, peak values occurring in the weld. Excellent cold bend ductility shown in photos for all weld metal and the joint section. Charpy impact is said to be 25 for plate and 30 for weld and between these ratios for material between parent and weld metal. Welded plate stressed parallel to weld requires high weld ductility to prevent fracture in the weld since during the stress the weld carries the same load as the plate material. Stress relief by peening or by heating to 1150° F. is required for thick sections. Pressure vessel curves are given of yield points of cylinder wall, unreinforced manholes, old type dished heads and these are compared with similar results on weld design of reinforced manhole and elliptical head; conclusion therefore is that 40% less weight and welded design would give same strength. Use of lime wash is recommended for non-destructive pressure test to reveal areas of local stress. WB (7b)

Welding Research at the Royal Naval College, Greenwich. *Welder,* Vol. 8. May 1936, pages 936-940, 953. Review of reports on physical tests, load carrying ability of welded joints of various types used in ship building. Results of tests indicated little difference between single and double V welds and high tensile strength of welds is not necessarily associated with brittleness. Oxyacetylene welds gave uniformly less satisfactory results and electric welds give properties closely approaching those of the plate. Results of fatigue tests on welds made with Haigh's push and pull machine show fatigue limits of 5½-6 tons/in.^{2} consistently obtained even when slag inclusions and gas cavities are present provided there is no lack of fusion at weld-plate surface. Criticism of the Wöhler type fatigue tests using a weld sample smoothly finished all over is made and figure of 12-14 tons/in.^{2} considered too high for conditions in practice where roughness, slots or keyways act as stress raisers. Discussion of tests on upper and lower yield points. Haigh's definition of lower yield point is recommended for general use in tensile testing with the consequence of use of yield figures for design rather than ultimate. Lower yield point is consistent, easily determined and closely related to loads at which plastic behavior becomes dominant. Prediction is made that lower yield point and fatigue limit will be most important design basis in the future. New theory of fatigue cracking is that "it is not directly due to the plastic action that produces yield in ductile metals through the agency of the mechanism revealed by "slip bands," but to a recrystallization associated with reduction of volume—causing tensile stresses acting in all directions with more or less equal intensity. Such combinations of tensions acting in all directions are described as "negative fluid pressures" or as "triple tensile stresses." Analogy of theory with recrystallization in creep is pointed out. The formation of the initial fatigue crack is attributed not to plastic yielding in the metal, but rather to the fact that it does not yield easily enough to save the metal in the cone from excessive fluid tension." WB (7b)

Combining Castings and Weldings. T. S. Quinn & John Howe Hall. *Industry & Welding, Executives' Quarterly,* Second Quarter, 1936, pages 51-54. Foundry shops are being called upon to supply increasing demand for castings to be assembled by welding into finished structure combining cast and rolled sections. For complicated structures casting usually is cheaper process as it involves no expensive cutting of parts as for welding. Weakest parts of castings and welds are apt to occur in similar places such as change in cross-section. Cast steel of .20-.30 C considered as easily welded as rolled structural steel. Several examples of cast-weld assembly are illustrated. WB (7b)

The Wist Process of Electric Welding (La soudure électrique Wist) L. Kirste. *L'Aéronautique,* Vol. 18, July 1936, pages 149-150. In the Wist process an arc is struck between concentric C electrodes between which alcohol vapor is blown. A long-pointed flame, having a very high temperature, is produced, and it is claimed that with this welding can be carried out 50 to 100 times more rapidly than with an oxy-acetylene blowpipe. JCC (7b)

The Electric Arc Welding Process. IV, V, VI. T. A. Long. *Welder,* Vol. 8, Apr. 1936, pages 900-903; May 1936, pages 932-935; June 1936, pages 964-967. Advantages of a.c. over d.c. are cited; absence of arc blow with a.c. is important for welding of corners. Arc blow is not serious between 50-260 amps. but for 22-20 gage sheet with 20 amps. arc blow is serious and a.c. is used with great advantage. Study of a.c. equipment is made and indicates constant current advantage in welding and advantage to electric power industry because of lack of large surge on short current. Power factor and correction methods are analyzed and calculations for size of welding transformer plants shown. Part V. Electrical considerations of multi-operator a.c. welding plants are detailed and operating characteristics discussed. Part VI. Low ducility and impact of bare wire welds are compared with covered rod. Output rating of a.c. and d.c. is discussed in detail; guaranteed continued output is best basis for purchase of machines. For a.c. machines a min. striking voltage of 90 should be available for wide flexibility of operation and better welding characteristics. Electrical efficiency is reviewed and it is shown that idle d.c. equipment consumes approx. 7 times more energy than idle a.c. Cooling is taken care of in design of d.c. rotating equipment. A.c. equipment may be either oil- or air-cooled. WB (7b)

Some Welding Jigs and Fixtures. J. Ashworth. *Welder,* Vol. 8, June 1936, pages 977-980. Requirements for welding jigs are: (1) accuracy to enable the operator to tack weld without measuring, (2) it must make the work accessible so operator can easily reach point to be welded, (3) it must be rigid to some extent depending upon the class of work to be welded, and (4) welder should be able to do his work with little or no change in position. Contraction during cooling of weld controls the amount of rigidity in jig and this depends on type and size of materials welded. Several examples of large and small jigs are shown. WB (7b)

Electric Arc Welding from the Scientific Viewpoint. J. H. Andrew. *Welder,* Vol. 8, June 1936, page 968. Welding process is regarded as that of making a small chill casting between two sections of metal in such a way that prior to solidification of the bulk of the liquid metal, a complete union between the small casting and the parent metal is brought about by diffusion. Too high a liquid metal temperature coarsens weld metal and overheats adjacent parent metal; if it is too low, no diffusion occurs. Electrodes of different composition have different melting temperatures and require adjustment of welding current. Normalization temperature is just attained in lower bead by succeeding bead and ideal conditions are considered to be obtained for a high crested weld, the crest of which is then ground or machined off. Low annealing temperature of 650° C. for stress relief is considered to be injurious to structure if temperature can rise to 680° C. due to grain boundary migration of carbides. Normalizing at 630° C. max. is considered better practice. Study of slags resulting from covered electrodes is recommended for determining oxidizing effects on rod alloys and physical properties of liquid and cold slag. WB (7b)

The Importance of Welding in Paint Plant. C. W. Brett. *Paint Technology,* Vol. 1, July 1936, pages 263-264. The advantages of welding in replacing parts over riveting are pointed out. One of the newest welding processes known as the British low-temperature method enables the heat developed to be localized so strictly that the expensive and time wasting preliminary of pre-heating is entirely obviated. This enables the repairing to be carried out without dismantling. WHB (7b)

Effects of Generator Characteristics on Welding Costs. John H. Blankenbuehler. *Canadian Machinery,* Vol. 47, May 1936, pages 49-52. See *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 452R/2. WB (7b)

Jigs and Fixtures for Resistance Welding Machines. H. C. Cogan. *Welding Journal,* N. Y., Vol. 15, July 1936, pages 9-15. A fixture holds and locates the work and is permanently attached to the welding machine. A jig does the same but is either portable or fixed so the welder can be brought to the work. Metals used for electrode tips, jigs and fixtures are discussed with emphasis on non-magnetic materials of construction for jigs and fixtures, such as Al bronze, Al and alloys, Ni cast iron, Cu. 13 rules are given for efficient operation. Discussion of series, multiple and indirect flash, seam, projection welding given with sketches. WB (7b)

The Gas Welding of Pressure Vessels and High Pressure Piping. W. A. Duncan. *Canadian Machinery,* Vol. 47, June 1936, pages 50-58. Paper at Interprovincial Boiler Inspectors Conference, Toronto, June 2, 1936. Discussion of Lindeweld method of welding with excess acetylene, to which is ascribed the production of welds free from inclusions, porosity and having high ductility due to reducing atmosphere of the flame. Diagrammatic comparison of above method with neutral flame welding is made and max. temperature for first is 2731° F. as against 2912° F.+ for latter. The use of above method with multiflame torches and semi automatic equipment is suggested for future high speed and low cost welding. Advantage of welded piping is reviewed. Procedures and rules of testing of pipe welds for welder qualification in Canada are detailed. WB (7b)

Welding of Aluminium-Magnesium Alloys. Fr. Eggelsmann. *Metal Industry,* London, Vol. 48, June 26, 1936, pages 711-715. A paper presented to the International Congress of Acetylene, Oxy-Acetylene Welding and Allied Industries. The author describes the procedure evolved for the successful welding of Al-alloys containing Mg. It was found that if attention was paid to the formation of a uniform underbead and a suitable flux was employed that slag-free and non-porous welds could be obtained. The alloy used had the following composition: Si 0.90%, Mg 1%, Mn 0.5%, Al-remainder. Test welds were made on plates 10 mm. thick and sheets 2.3 and 4 mm. thick. Autogal D was found to be the most satisfactory flux. Precautions to be closely observed are cleanliness, the use of freshly prepared flux paste, selection of the proper size of blowpipe and the use of a soft flame with an excess of acetylene. Micrographs of several welds are included and the grain structure of the weld is discussed. It is stated that hammering the weld, even if subsequently annealed, is injurious to the weld. The type of test piece used is described and physical properties obtained are discussed. A practical application of this method of welding is described. It is the welding of 6/11 mm. tubes into end plates of the same material 70 mm. thick. The results obtained were considered satisfactory as the joint withstood a water-pressure of 4266 lb./in.^{2}. The author summarized the results as (1) welding these alloys presents no difficulties if the proper flux is used, (2) slag-free and non-porous welds can be made, (3) the structure of the weld is finer than the parent metal, (4) hammering the weld does not smooth out the sharp transition in structure and is not advised, (5) the strength of the weld is higher than that of the parent metal but elongation is lower, (6) the mechanical properties obtained satisfy all the demands placed on welded joints. HBG (7b)

Evolution of the Welded-tube Industry. Gilbert Evans. *Metallurgia,* Vol. 14, Aug. 1936, pages 95-98. History of development of welded tubing is reviewed. The Fretz-Moon process is described and its advantages over older processes discussed. JLG (7b)

The Determination of the Quality of Fusion Welded Joints. E. R. Fish. *Welding Journal*, N. Y., Vol. 15, July 1936, pages 19-21. Knowledge of exact results of operator's efforts in welding through qualification tests including physical and X-ray tests of welds stressed as necessary for procedure control. Older welded pressure vessels are entirely lacking in procedure control and many have been found unsafe to use when investigated by cutting out cylindrical coupon across the weld (see "Inspection of Welded Seams in Pressure Vessels," *Metals & Alloys*, Vol. 7, June 1936, page MA 299L/1). After fabrication it is recommended that final item of inspection include coupons from a predetermined number of feet of welded joint to test weld quality and holes in vessel plugged with threaded plug. WB (7b)

F. E. C. Erects First All-Welded Bascule Span. T. H. Gardner. *Railway Age*, Vol. 101, July 18, 1936, pages 100-104. Details of welded structure are discussed. CBJ (7b)

Chrome Molybdenum Steel for Aircraft. A. J. Herzig. *Aero Digest*, Vol. 29, July 1936, pages 32-33, 36. Discussion of SAE 4130x Cr Mo steel, heat treatment and physical properties for the treatments. Recommendations are given for welding of the steel, welding rod and heat treatment after welding. WB (7b)

The Welding of Dairy Equipment. J. Hinde. *Welder*, Vol. 8, May 1936, pages 941-942. Stainless 18-8, Inconel, Sn coating, Al and glass lining are considered best for milk tank surface in contact. Fe, Cu, Ni, Cr steels are not satisfactory. WB (7b)

Welding Metals Without Fusion by "Molecular Shock." A. H. Allen. *Steel*, Vol. 98, June 22, 1936, pages 34-36. Brief account of method developed by Antonio Longoria. High frequency electric current applied to metal heated to 700° F. breaks down molecular bond in edges of abutting pieces and they weld together. Tapped seams may also be welded, result resembling a stitch weld or continuous spot weld, except that each spot represents current flow of 1/10 cycle, using 60-cycle power. No pressure is required on pieces to be butt welded. Equipment involves a movable table to which pieces to be welded are clamped, and a welding head under which table travels as abutting edges are joined. Equipment requires less space than present types and can be built at considerably less cost. Process has been applied successfully to thin sheets of non-ferrous metals. Line of weld in these was a thin band of slightly discolored metal, with practically no bead. Weld in 28-gage stainless steel had tensile strength within 0.1% of that of base metal. 16-gage galvanized steel sheet has been welded at rate of 64 ft./min. with low power consumption. See also "Wire Mesh and Sheets Welded Without Fusion," *Metals & Alloys*, Vol. 7, June 1936, page MA 298L/6. MS (7b)

Bronze-Welded Monel Metal. O. C. Jones. *Welding Journal*, N. Y., Vol. 15, July 1936, pages 18-19. Brief discussion of building up of worn Monel laundry equipment by depositing bronze and finishing to original size. Photos illustrate the built up sections. WB (7b)

Building-up by Welding of Frogs and Rail Crossings (Aufschweissen von Herzstücken im Geleise) F. Golling. *Autogene Metallbearbeitung*, Vol. 29, June 1, 1936, pages 166-171. Experiences of the German and Polish state railways are reported, great economies have been made in building up worn parts by welding which formerly were sold as scrap. The welding rod that gave best results had a composition of 1.2% C, 0.2% Mn, 0.12% Si, 0.9% Cr, 1.7% W. It assumed finally, under the cold-rolling action of the wheels, a Brinell hardness of 280, and the built-up part showed little, uniform wear in service. If more Cr and C is contained in the added material the weld is liable to spall or small pieces break off. The procedure is described in full. Ha (7b)

Handling Distortion in Maintenance Welding Operations. George W. Hettrick. *Canadian Machinery*, Vol. 47, Jan. 1936, pages 51-55. See *Metals & Alloys*, Vol. 7, Mar. 1936, page MA 128R/6. WB (7b)

Welding with Covered Electrodes. J. F. Lincoln. *Metal Progress*, Vol. 29, Jan. 1936, pages 34, 80. See "Metallurgy of the Welding Electrode in the Arc," *Metals & Alloys*, Vol. 7, Mar. 1936, page MA 130L/7. WLC (7b)

Supplies Flame-Cut Steel Shapes. Fred B. Jacobs. *Steel*, Vol. 98, June 15, 1936, pages 38-40. Describes and illustrates some of the flame-cutting operations performed at plant of Reliable Steel Plate Co., Cleveland, O., in producing a wide range of shapes in thicknesses from 3/16" to 12". Machine mounted natural-gas torches are used. It is claimed that flame action with natural-gas does not case-harden stock at kerf sides. MS (7b)

Welded Construction of Butane Powered Locomotives. George Kirtley. *Industry & Welding, Executives' Quarterly*, Second Quarter, 1936, pages 58-59. General, brief description. WB (7b)

Design of Welded Steel Structure. Robert E. Kinkead. *Welding Journal*, N. Y., Vol. 15, July 1936, pages 30-31. Brief talk reported as presented at local Pittsburgh, Pa. section of American Welding Society. Advocates non-uniformity of steel in plate, sections or structure as required for local strengthening, surface corrosion resistance as exemplified by welded inserts of low alloy high tensile steels, local hardening of rail joints and ply-sections with thin corrosion resisting surfaces. Most economical design is not structure with uniform strength material throughout, but structure where low cost material is used for low stresses and high strength material only where required. WB (7b)

A Welded Reaction Chamber. *Welder*, Vol. 8, June 1936, pages 974-976. Photographic review is given of construction of 5' I. D. vessel forged from hollow ingot with end nozzles welded in. Wall thickness of vessel was 3⅝" and it was 25' long. Vessel was set upright for welding in nozzles; gas preheat was used during welding. Hinge lugs for door and thermocouple pads were welded on. WB (7b)

Gas Holders in Spain Repaired by Electric Welding. *Welder*, Vol. 8, May 1936, pages 950-953. Details of welding discussed with illustrations. WB (7b)

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Welding in the Coal Industry. *Oxy-Acetylene Tips*, Vol. 15, June 1936, pages 125-130. Maintenance work in mining operations with the oxy-acetylene blow-pipe is described. Ha (7b)

Saw Welding. *Oxy-Acetylene Tips*, Vol. 15, Feb. 1936, pages 36-38. Due to the particular quality of the material it must not be overheated when welding for repairs; this is accomplished by welding a small spot of about 1 in.^{2} at a time; backhand welding is employed. The procedure is described in detail. Ha (7b)

Permanency of Oxy-Acetylene Welding. *Oxy-Acetylene Tips*, Vol. 15, Apr. 1936, pages 77-81. A piping system with ox-welded joints withstood corrosion, hurricane, flood and earthquake. Ha (7b)

Steel Mill Ladle and Cars. *Oxy-Acetylene Tips*, Vol. 15, Jan. 1936, pages 11-12. Flame-cutting as means for cutting shapes used for heavy equipment is described. Ha (7b)

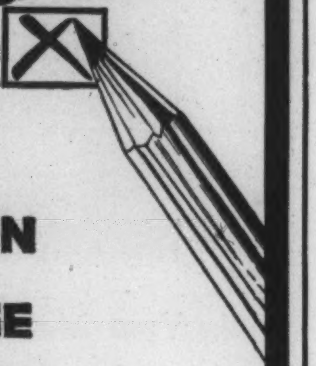
Valve Disc Hard-facing Methods. *Oxy-Acetylene Tips*, Vol. 15, June 1936, pages 131-132. Preparation for hard-facing and rough and finish grinding operations are outlined. Ha (7b)

Heat Treating of Welded Tubes to Prevent Mill Scale Formation. *Oil & Gas Journal*, Vol. 35, Aug. 27, 1936, pages 70, 72-73. Description of the Johnston welding process and the controlled-atmosphere heat treating furnace of Steel & Tubes, Inc. VVK (7b)

Welding Builds a Factory. *Engineering News-Record*, Vol. 117, July 10, 1936, pages 90-93. 9 buildings involving 2,600 tons of steel were completely welded. CBJ (7b)

Welding Rock Drills (Schweissungen an Erdbohrern) Fr. Riedig. *Elektroschweissung*, Vol. 7, May 1936, pages 87-89. Instead of diamonds, layers of W carbides are welded on the edges of rotary-drills. Powdered W carbide is strewn on the edges of the tool and melted down with the direct C arc. The first layer is partially dissolved in the surface of the steel, therefore 2 or 3 layers are necessary if the highest hardness is desired. Percussion drills are welded with "Verdur," a mixture of W carbides in a thin tube of alloyed steel, which is used like a normal welding rod. Widia is welded upon rotary-drills with rods of "Diaweld." These rods possess a low melting point, therefore they are melted down with the flame. "Verdur" and "Diaweld" give tools of high ductility. HR (7b)

Advantages of Welded Construction of Power Presses. E. Wiedmann. *Industry & Welding, Executives' Quarterly*, Second quarter, 1936, pages 65-67. Advantages are appearance, greater strength and wider adaptability. Evolution of presses from cast to welded design is shown. Large vertical and horizontal swaging presses are illustrated as weld designed. WB (7b)



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Welded Construction at Hiram Walker Plant. L. P. Weiner. *Industry & Welding Executives' Quarterly,* Second Quarter, 1936, pages 60-62. Welded kettles, fermenters, etc., preferably have a welded, flush interior construction in order to provide total enclosure against air contamination, recovery of CO_2 for Dry-Ice and to prevent lodging of grain on walls such as would occur on other seamless, flush type structures. WB (7b)

The Oxygen Lance. *Oxy-Acetylene Tips,* Vol. 15, Aug. 1936, pages 173-178. Uses of the oxygen lance which simply consists of a pipe through which O flows under regulated pressure, are described for other industrial processes than opening tap holes in blast-furnaces or open-hearth furnaces, e.g. cutting holes in ferrous metals by introducing O into an already started Fe oxidation reaction, or in non-ferrous metals where the lance supplies the entire amount of heat required for producing a fluid slag by reaction with the Fe oxide. Operation of the lance is described in detail for several operations. Ha (7b)

Machine Cutting—A Modern Production Tool. *Oxy-Acetylene Tips,* Vol. 15, May 1936, pages 101-106. The many advantages of oxy-acetylene machine cutting in industrial manufacturing processes are reviewed and examples described. Ha (7b)

$3700 Saved is $3700 Earned. W. B. Boom. *Industry & Welding, Executives' Quarterly,* Second Quarter, 1936, page 63. Brief description of large steel press brake for bending shapes. It will bend plate 16′ long and ¾″ thick in 15 seconds. Machine is entirely welded; construction and costs saved are itemized as, $2,000 in elimination of 16 patterns, machining costs $1500 less, savings on pattern drawings about $200. WB (7b)

Arc Welded Highway Bridges in Tasmania. G. D. Balsille. *Welder,* Vol. 8, Apr. 1936, pages 914-916. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 131L/8. WB (7b)

Residual Stresses in Arc-welded Plates. N. S. Boulton & H. E. Lance-Martin. *Electrical Review,* Vol. 118, Apr. 24, 1936, pages 601-602; *Sheet Metal Industries,* Vol. 10, June 1936, pages 481-482. See *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 450L/8. MS + AWM (7b)

Welding Aluminum Bronzes (Considerations sur la Soudure des Bronzes d'Aluminium) A. Boutté. *Cuivre et Laiton,* Vol. 9, Aug. 30, 1936, page 375; *Sheet Metal Industries,* Vol. 10, July 1936, page 563. Paper presented at the 12th International Congress of Acetylene, Oxy-Acetylene Welding and Allied Industries in June. Mechanical properties of 85-90% Cu and 9-10% Al are discussed. They can be forged, hammered cold and hot, are non-oxidizing up to 800° C. and are not attacked by many chemicals. The heat treatments to increase hardness are described; quenching from 800° C. increases hardness and reduces elongation after drawing at 400° C. while it is the reverse after drawing at 500° C. Sheets of 0.5 to 24 mm. can be welded successfully if a suitable flux containing cryolite is employed. Ha + AWM (7b)

Bridge Welding—A Review of the Literature. F. H. Frankland. *Welder,* Vol. 8, May 1936, pages 954-956; June 1936, pages 986-989. See *Metals & Alloys,* Vol. 7, May 1936, page MA 241L/10. WB (7b)

New Welding Method by Application of Heat and Pressure. Leonard C. Grimshaw. *Engineer,* Vol. 162, Aug. 21, 1936, pages 190-191. See *Metals & Alloys,* Vol. 7, May 1936, page MA 238R/9. VSP (7b)

Gas Welding of Class One Pressure Vessels. G. W. Plinke. *Oil & Gas Journal,* Vol. 34, Apr. 2, 1936, pages 33-34, 36, 39. See *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 450R/5. VVK (7b)

Tests to Determine the Feasibility of Welding the Steel Frames of Buildings for Complete Continuity. W. M. Wilson. *Welder,* Vol. 8, Apr. 1936, pages 904-909; May 1936, pages 943-947; June 1936, pages 981-982. See *Metals & Alloys,* Vol. 7, June 1936, page MA 301L/8. WB (7b)

Regulations for Welded Steel Road Bridges with Full-Walled Girders (Vorschriften für geschweisste vollwandige stählerne Strassenbrücken) *Zwanglose Mitteilungen des Fachausschusses für Schweisstechnik im Verein deutscher Ingenieure,* No. 29, July 1936, page 7. The German specifications are compiled in the DIN E-4101. The necessity for paying attention to the dynamic stresses in such structures is particularly stressed. Ha (7b)

Institution of Mechanical Engineers—Welding Research Committee's Second Report. *Welding Journal,* London, Vol. 33, May 1936, pages 144-148. Extracts of the report are given. Rather than make a survey of electrode composition and manufacture for best welding conditions the committee undertook a program of utilizing a few typical commercial electrodes for the welding tests on 4 groups of steel plates graded as to tensile strength as grade (1) 22-24 tons/in.^{2}, grade (2) 27½ tons/in.^{2}, grade (3) 31½ tons/in.^{2}, grade (4) 35 tons/in.^{2} The weld metal was investigated as to physical properties, effect of annealing and normalizing on these properties, corrosion resistance; X-ray and spectra analyses were also made. The welded plates were examined in as welded, normalized condition (900°-910° C.) and after low temperature anneal. Short time tensile, long time creep, Izod, aging tests (impact) at 250° and 450° C. aging tests (impact) after water quenching from 730° and 650° C.; cold bend, repeated impact tests were made on the welded plates. Conclusions are: (1) C and Mn of weld may differ widely from electrode, (2) an extra layer of weld metal laid over a V weld may produce an appreciable depth of normalizing of the weld metal, (3) cavities and inclusions exist in all welds except the best and may reduce fatigue range of weld; X-ray shows location, size and number of cavities and inclusions, (4) creep of weld metal about same as mild steels, at boiler temperatures without preheat there is no creep danger, (5) impact results indicate no danger from embrittlement in boiler service, (6) bend test should include % elongation of weld metal at surface of the V after bending, (7) repeated stress resistance for welds is less than for unpierced plates of same tensile strengths, (8) selection of electrode and welding technique is important for minimum cavities and inclusions in weld, (9) corrosion tests indicate no greater corrosion of weld than of plate. WB (7b)

Welded Mild Steel Drums. *Welding Journal,* London, Vol. 33, May 1936, page 140. Brief note on new British specification No. 670-1936. 3 classes of drums are considered for the specifications according to corrosion hazard and specific gravities in 5 to 150 gallon capacities. Specification does not include material of lower thickness than 18 B. G. WB (7b)

Arc Welding of a Special Steel. L. Sanderson. *Metallurgia,* Vol. 14, June 1936, page 48. Discusses welding of high-Mn steel. JLG (7b)

Welding the Servel Refrigerator. R. S. Taylor. *Industry & Welding, Executives' Quarterly,* Second Quarter, 1936, pages 42, 44. Brief details given. Both gas and arc welding used. WB (7b)

Welded Stainless Equipment. George H. Tay. *Industry & Welding, Executives' Quarterly,* Second Quarter, 1936, pages 68-69. Cookers, storage and mixing equipment for foods are made of welded stainless with welds ground flush with plate. Satin finish for polish is sufficient for most materials though high polish is necessary for corrosive materials. No welds are made in corners where joint cannot be ground because of danger of contamination and fermentation from food lodged there. When properly welded and polished the joint is practically invisible. WB (7b)

Welding in the Manufacture of Salt. S. H. Zimmerman. *Industry & Welding, Executives' Quarterly,* Second Quarter, 1936, pages 55-57. Welding was chosen for evaporators due to reduction in weight and cost and assurance of tight joints. Repairs and installation of Monel plates are done by means of welding. Removal of gypsum incrustation from inside of tubes is now done with arc weld hard-faced bits which outlast former tempered steel bits in ratio of 7-1. Necessity for smooth walls on evaporating equipment and conveying belts made of monel requires us of welding rather than riveting. WB (7b)

Welding Sensitivity (Heat Cracking) (Zur Frage der Schweissempfindlichkeit) K. L. Zeyen. *Technische Mitteilungen Krupp,* Vol. 4, Aug. 1936, pages 115-122. Weld sensitivity or heat-cracking is that phenomenon in metallic materials which occurs during or after welding and consists in formation of cracks along the seams. In general, welding sensitivity increases with decreasing thickness of the material, with increasing strength of the material, and with increasing complexity of the structure to be welded. The causes can be outside the material, i.e. incorrect design and defective workmanship, or defective material. The former comprise overheating, welding on one side if previously another weld was made at the same place on the other side, improper cooling, sequence of welding. The causes are often seen to be unsuitable welding rods, e.g. high C steel or high alloy steel which produce hard welds. Welding sensitivity of alloy steels increases with increasing Mo, Cr and Mn content, and in C steels with increasing P and S content; the maximum content of P + S should not exceed 0.035%. Open-hearth steels are in general much more weld-sensitive than electrically produced steels. A further cause of heat-cracks was found in wrong heat treatment or cold working which result in excessive strains, and can be prevented by air-normalizing before welding. Test results are given in detail. 9 references. Ha (7b)

Electric Arc Welding and Its Applications. XII. M. MAURICE LEBRUN. *Welding Journal,* London, Vol. 33, May 1936, pages 134-137. Practical discussion of application of arc welding methods for joining plates, ribs, angles for ships and for liquid transportation tanks under high pressure. WB (7b)

Autogenous Welding and Ship Boilers (Soudures Autogène et les Chaudières de Navires) M. LEBRUN. *Usine,* Vol. 45, May 14, 1936, page 31. Advantages in welding the boilers of a passenger liner are briefly discussed. Ha (7b)

Double-Track Bascule Span Employs Welded Design. HEATH LAWSON. *Engineering News-Record,* Vol. 117, Sept. 17, 1936, pages 408-409. Erection and field welding of bridge are discussed. CBJ (7b)

Correct Preparation for Electric Resistance Welding (Schweissgerechte Vorbereitung zur elektrischen Widerstandsschweissung) W. KÜRSCHNER. *Elektrowärme,* Vol. 6, Aug. 1936, pages 239-241. Points to be observed in properly handling the material and arranging the welds and precautions to take when sections of largely differing dimensions must be butt-welded together are discussed. Ha (7b)

Investigations on the Fatigue Limit of Welds in Steel 52 (Untersuchungen über die Dauerfestigkeit von Schweissverbindungen an St 52) A. MATTING & G. OLDENBURG. *Elektroschweissung,* Vol. 7, June, 1936, pages 108-111. An explanation of the low fatigue limit of welds is found in the difference of elastic limits between the weld and the welded material. It is assumed that the phenomenon is governed by other factors also. HR (7b)

The Training of Welders, Supervisors and Draughtsmen. III, IV, V. H. MARTIN. *Welder,* Vol. 8, Apr. 1936, pages 923-924; May 1936, pages 948-949; June 1936, pages 984-985, 989. Series of articles giving directions for teaching students the welding of plates at right angles to each other, which covers 70% of welds in field, and butt welding. Part V discusses contraction stresses. The stress relief of structures with widely varying cross sections is considered to be dangerous and the practice of balancing welding cycles to oppose contraction strains is recommended. WB (7b)

Do Alloying Elements Burn Away when Welding Light Metals (Findet beim Leichtmetallschweissen ein Abbrand von Legierungsbestandteilen statt)? M. MAIER. *Aluminium,* Vol. 18, Aug. 1936, pages 373-374. Tests showed that no appreciable accumulation of the more difficultly burning constituents, nor a reduction of the easily oxidizing constituents takes place. The use of a flux reduces the burning of Si. Ha (7b)

Toronto Welding Practice Standardized—The Way Department of the T. T. C. Has Standard Methods for Doing Various Types of Repair Work on Rail Joints and Special Track Work. W. A. MACRAE. *Transit Journal,* Vol. 80, Aug. 1936, pages 267-269. Specific methods of repairs made on track work are outlined and illustrated, also the types of repairs effected. WHB (7b)

Arc Welded High Pressure Vessels (Elektrisch geschweisste Hochdrucktrommeln) FRANZ NEHL. *Elektroschweissung,* Vol. 7, May 1936, pages 81-86. Vessels for pressures over 60 atm. are seldom welded with watergas as with ordinary steel the thickness of walls is too great and for alloy steels watergas welding is not suitable. Welds in high pressure vessels must possess a tensile strength not less than 90% of the sheet and endure a bending test over 180°. These requirements are met by heavy coated rods of ordinary steel, but with this the necessary tensile strength at elevated temperatures cannot be reached. In order to do so, coatings are provided with an addition of Mo. New difficulties are encountered with vessels of alloyed steels. Rods with small additions of Ni and Cr give welds with low ductility, whereas with austenitic rods the welds cannot be annealed without danger of loss of tensile strength. Annealing is indispensable in view of the tensions to be removed after welding. Good results were obtained with Cu steels containing a small amount of Ni. The electrode contained 0.7% Cu with some Ni and the coating was given an addition of Mo. This electrode had a good flow, the Cu was transferred without loss in the weld, which moreover showed a content of 0.2% Mo. The weld was, as could be shown by microscopic and X-ray inspection, free from pores and failures. Unfortunately the bending angle did not exceed 120°. Full success was attained by the application of precipitating heat treatment (several hours at 640°-660° C.). Further advantages of Cu-steel are: absence of hot-shortness and diminution of scale in consequence of electrochemical effects, high tensile strength at normal and elevated temperature. Mechanical properties obtained in practical tests are:

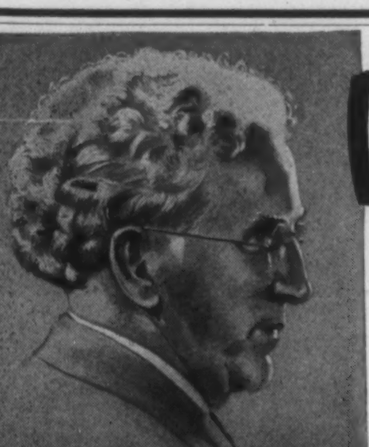
	Sheet			Weld		
temperature °C	yield-point kg./mm.²	tensile-strength kg./mm.²	elongation %	yield-point kg./mm.²	tensile strength kg./mm.²	elontion %
20	34.4	53.6	27.0	34.6	54.2	19.2
200	31.0	47.9	24.1	29.8	50.1	19.9
300	26.9	47.5	21.1	25.0	48.9	19.6
400	24.3	49.7	15.6	22.1	50.3	13.7
500	19.7	42.8	17.4	20.0	50.5	15.5

HR (7b)

The Resistance Welding Circuit. C. L. PFEIFFER. *Electrical Engineering,* Vol. 55, Aug. 1936, pages 868-873. A consideration of the problems encountered in the practical application of the resistance welding circuit, with emphasis on the electrical constants and variables involved. Improvement in resistance welding processes involves absolute control of power input to the weld area. The ideal way to make perfect welds is to control the energy input to the weld area, which means control of current value through the weld, voltage drop across the weld, and time of current application. WHB (7b)

Electrical Spot-, Multiple Spot- and Seam-Welding (Elektrische Punkt-, Mehr Punkt- und Nahtschweissung) ROSENBERG. *Elektrowärme,* Vol. 6, Aug. 1936, pages 242-243. Manual and automatic processes and control arrangements are described. Ha (7b)

Track Welding Practices of the Chicago Surface Lines. JONATHAN WOLFE. *Mass Transportation,* Vol. 32, May 1936, pages 145-147, 158; June 1936, pages 167-168. Resistance welding, carbon arc welding and thermite welding operations are described. Welding negative cables, burning apart old rails and steel, and fabrication of special work by welding are discussed. CBJ (7b)



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Welded Truck Frames for B. M. T. Lines. Multi-Section Cars. G. D. SPACKMAN. *Welding Journal,* N. Y., Vol. 15, July 1936, pages 27-30. Experimental truck frames were built up of welded Cromansil steel. A large number of cars were ordered with welded trucks using pressed plate members of Cromansil and electric furnace castings of Cromansil analysis. Design stress in trucks is approximately 24,000 lbs./in.^{2} which is about 40% of endurance limit for parent metal in rotating beam tests. All trucks are heat treated after welding even though low C content of .17% is not dangerous in welding heat region. Destruction tests made on a truck frame indicated satisfactory strength. WB (7b)

Principles and Application Possibilities of the Various Electric Welding Methods (Grundlagen und Anwendungsmöglichkeiten der einzeinen elektrischen Schweissverfahren) K. SIEMERS. *Elektrowärme,* Vol. 6, Aug. 1936, pages 230-237. The mechanism of electric arc heating, resistance welding, temperatures obtainable, types of electrodes for a.c. and d.c. welding, weldability of the different metals, and welding machines are discussed. Examples of welded parts and structures are given in illustration of the principles involved. Ha (7b)

Marion Gives Welding a Plus Rating. D. J. SHELTON. *Industry & Welding Executives' Quarterly,* Second Quarter, 1936, pages 48-50. Review of evolution of power shovel with major parts of the machine of all weld construction. Photos illustrate construction and assembly. WB (7b)

Stainless Steels. Part IV. E. C. ROLLASON. *Welder,* Vol. 8, Apr. 1936, pages 917-922. Corrosion of weld, effect on plate corrosion, fluxes for welding, soldering and brazing are discussed, several formulae for the latter being given. Brief review of effect of C in gas weld flame, expansion coefficients for various Cr and Cr Ni alloys compared with Fe and Cu for 20-100° C. and 20-600° C. and effect on welding strains are discussed. Curves are given for Brinell of 18-8 stainless rolled 50% and annealed at 500°-1150° C. with .09 C, 3.9 Mo, .67 Ti; curve for 22-9 stainless with 2.4 Si is compared with mild steel. Curves are also given for Brinell vs. % reduction in cold rolling as indication of work hardening of 18-8 showing effect of addition of .09 Ni, .05 C, 3.9 Mo, and .67 Ti, to 18-8, .25 Si to 22-9 stainless as compared with 13.5 Cr and mild steel. Largest increase in hardness occurs in 18-8 having .09 C, then .05 C, .67 Ti, 2.5 Si, and 3.9 Mo last. Table of mechanical properties of various stainless steels is included. Short time tensile and creep data are given for low and high carbon 18-8 respectively. WB (7b)

Special Fabricating Methods Employed in Making Heat Exchanger Tank. F. M. YOUNG. *Steel,* Vol. 98, May 25, 1936, pages 64,66. Describe methods used in fabricating unit used in brine holdover system of mechanical refrigeration for railroad air conditioning. Tank is made of 2 pieces of steel plate, edges of which are turned in and welded together electrically, forming guides which support coil. Bottom plate is placed inside the tank ¼" from bottom. Bead is welded electrically around inside of tank against outer surface of bottom plate. Fe bands are welded around tank at several places to reinforce it. MS (7b)

8. FINISHING

H. S. RAWDON, SECTION EDITOR

Selection, Application and Use of Finishes for Metal. *Steel*, Vol. 98, Mar. 16, 1936, pages 32-35; Mar. 30, 1936, pages 53-54, 56-57; Apr. 13, 1936, pages 48-49, 56; Apr. 27, 1936, pages 48, 50, 52; May 11, 1936, pages 70-72; May 25, 1936, pages 50, 52; June 8, 1936, pages 40, 42, 46; June 22, 1936, pages 47-48, 50. Discusses the subject from user's point of view. Outlines basic factors on which selection of finishes depends and then deals with various finishes available, including metallic coatings, organic finishes, and surface conversion treatments, and testing of organic coatings. MS (8)

■ 8a. Pickling ■

Etched Stainless Steel opens new Fields to Architects and Designers. *Steel*, Vol. 98, May 18, 1936, page 45. The usual procedure in etching 18-8 Cr-Ni stainless steel requires a solution of $FeCl_3$ or HCl as etching agent. Solution is either agitated by air or the plates are moved in the solution. About 30 min. is required to etch to a depth of 0.003″. Etched plates are washed thoroughly in running H_2O and then immersed in HNO_3 to restore passivity. Etched portion may be filled with colored enamel if desired. MS (8a)

Effect of Time, Temperature and Concentration of Sulphuric Acid upon the Rate of Pickling. G. L. Bryant & F. R. Porter. *Better Enameling*, Vol. 7, Jan. 1936, pages 18-20, 28. 2″ x 2″ plates were sheared from 20 gage enameling stock, cleaned to remove grease, dried, and weighed on an analytical balance. They were pickled for periods of 10, 20, 30, 40, and 50 minutes in 4%, 6%, and 8% by weight of H_2SO_4 at 140°, 160°, 170° and 180° F. The pickled panels were rinsed in water, dried, washed in alcohol, and weighed. Increase in temperature greatly increased the rate of reaction. Increase in concentration of acid from 4% to 8% increased the rate of reaction up to 6%, with an increase from 6% to 8% the rate decreased. An increased pickling period increased the rate at 140° and 150° F. with 4% acid and at 140° F. with 6% and 8% acid. Increasing the time of pickling at 170° and 180° F. with 4% acid and 160°, 170°, and 180° F. with 6% and 8% acid did not increase the rate. Increasing the pickling period increased the weight loss in every case studied but not the rate of reaction. Standard pickling practice in porcelain enamel industry of 6% H_2SO_4 at 160° F. is thus indicated as being good practice. CBJ (8a)

Treatment of Galvanized Sheets for Painting. J. L. Schueler. *Journal American Zinc Institute*, Vol. 17, 1936, pages 93-98. Wherever possible the sheet should be allowed to age or weather before paint is applied. If that is not possible etching should be used. When a chemical etchant is employed it is important that the action is not too strong. Acids should be avoided. A neutral solution of $CuSO_4$, or $SbCl_3$ works well. The Zn surface must be dry and free from all foreign material before paint is applied. BHS (8a)

Rational Use of Inhibited Pickling Baths for Ferrous Components. P. Mabb. *Sheet Metal Industries*, Vol. 10, July 1936, pages 537-539. The author points out that the speed and other merits of the usual pickles are not diminished by inhibitors. Acid consumption is reduced and over-pickling eliminated. 4 curves show the decrease in weight loss brought about by various inhibitors. AWM (8a)

The Spoilage of Non-ferrous Components by Acid Pickling. E. E. Halls. *Metallurgia*, Vol. 14, Aug. 1936, pages 91-93. Discusses bright pickling of Cu-base alloys. The concentration of the acid bath, its temperature, and immersion period must be kept within narrow limits. A number of recommended acid baths are given together with data on rate of solution of alloys in various other baths. JLG (8a)

■ 8b. Cleaning including Sand Blasting ■

Sandblasting Apparatus with Centrifugal Projection without Compressed Air (Appareils a Jet de Sable à Projection centrifuge sans air comprimé) E. Monnot. *Revue de Fonderie Moderne*, Vol. 30, June 25, 1936, pages 211-214. Principle of the machine and range of application are described; the method is less suitable for small pieces and for very large pieces of irregular shapes than sandblasting with compressed air. Ha (8b)

Cleaning Sheet Metal Parts for Porcelain Enamel. *Better Enameling*, Vol. 6, July 1935, pages 18-19, 24-27. In cleaning, the removal of oil and grease is accomplished either by an anneal or by caustic soda and other alkali usually in boiling solution. H_2SO_4 or HCl pickling solutions are commonly used to remove rust and scale. Ni plating has proved advantageous in preventing enameling defects such as fish scale and in improving the adherence of the enamel. Equipment used and control methods are discussed. CBJ (8b)

Sand- and Shot-Blasting. J. H. D. Bradshaw. *Foundry Trade Journal*, Vol. 54, Mar. 12, 1936, pages 205-208. Paper read before the Sheffield branch of the Institute of British Foundrymen. Hardness determinations of particles of chilled-steel abrasive made with the Firth Hardometer using the diamond indenting tool indicate a Brinell diamond hardness from 750 to 875. Nozzles worn beyond the limit of good practice increase the total sand-blasting costs by many times the price of new nozzles. Nozzles are usually made of a hard white cast Fe, but gas tubing is sometimes used. Commercial nozzles are now available which have a guaranteed working life of 1500 hrs., during which time the outlet will not enlarge more than 50% of its original diameter. This nozzle is mild steel lined with Norbide (boron carbide, B_4C). AIK (8b)

A Centrifugal Method of Cleaning Castings. Martin H. Kidder. *Better Enameling*, Vol. 6, Nov. 1935, pages 14-18. Discusses cleaning by tumbling and by a blast of abrasive thrown centrifugally and tangentially against the work by a mechanical device. CBJ (8b)

Cleaning and Prime-coating the Surfaces of Heavy Machinery. E. A. Zahn. *Industrial Finishing*, Vol. 12, May 1936, pages 13-14. **Cleaning Small Steel Parts Preparatory to Finishing.** June 1936, pages 20, 22. **The Dangers of Rust.** July 1936, pages 19-20. **Prime Coating in the Foundry.** Aug. 1936, pages 19-20. The first 4 of a series of 20 articles on industrial finishing. Part I, shows advantage of blasting over other methods of cleaning. Priming coat should be applied immediately after cleaning and all parts must be cleaned before each coat of paint if they have been handled. Part II describes briefly the various cleaning solutions, their application and merits. Part III, emphasizes the importance of removing rust from metal prior to painting; application of paint to rusted articles is not recommended. Part IV, recommends the prime coating of castings before they leave foundry as this will eliminate rusting and subsequent paint failures. VSP (8b)

Cleaning Cast Iron Parts for Porcelain Enameling. *Better Enameling*, Vol. 6, Aug. 1935, pages 14-18. Various types of sandblasting are described. CBJ (8b)

■ 8c. Polishing & Grinding ■

Burnishing Procedure for Aluminum Screw Machine Products. J. F. Coneen. *Metal Industry*, New York, Vol. 34, Aug. 1936, page 301. Equipment, materials, and procedure in burnishing Al screw machine products are described. CBJ (8c)

Honing of Cylinder Bores (Das Honen von Zylinder-Bohrungen) Koch. *Oberflächentechnik*, Vol. 13, Aug. 4, 1936, pages 173-175. Principles and development of methods for finishing processes by honing are discussed; the modern process of honing combines a rotating motion with a reciprocating motion whereby the honing tool is pressed against the cylinder wall. The principal advantages are accuracy and speed. Ferrous alloys of any hardness can be honed with advantage but non-ferrous metal cannot so far be honed successfully as the honing stones clog and smear up. Procedures, mechanical and automatic equipment and cooling methods are described. Ha (8c)

Barrel Burnishing. Walter R. Meyer. *Metal Industry*, New York, Vol. 34, Mar. 1936, pages 101-102. Extended abstract of "Das Polieren in Trommeln," F. Schwarz, *Oberflächentechnik*, Vol. 12, No. 20, 1935, pages 243-247. See *Metals & Alloys*, Vol. 7, June 1936, page MA 302R/6. CBJ (8c)

■ 8d. Electroplating ■

Bright Nickel Plating. A Critical Study. L. E. Stout. *Electrometallurgy*, supplement to *Metal Industry*, London, Vol. 48, June 26, 1936, pages 722-723. The article is from a recent address to the American Electro-Platers' Society describing a series of studies of commercial "addition agents or brighteners" for producing "bright Ni." Each was studied under its prescribed conditions, was tested by adding it to a single salt bath of $NiSO_4$ 12 oz., $NiCl_2$ 4 oz., boric acid 2 oz., H_2O 1 gallon, and also compared with the commonly used addition agents as lactic acid, malic acid and glucose. This study was not a theoretical one, but rather to obtain practical information for the plater. Only under the prescribed conditions could good results be obtained. In his experience the author has not, as yet, been able to obtain bright plated Ni that could be called "brilliant" or comparable to a properly buffed nickeled surface in taking a deposit of Cr. HBG (8d)

"Trouble-Shooting" on Electroplating Generators. L. L. Stoffel. *Metal Industry*, New York, Vol. 34, Sept. 1936, pages 339-341. Cures for common troubles which occur in routine practice are discussed. CBJ (8d)

Some Recent Developments in Chromium Plating. Herbert R. Simonds. *Iron Age*, Vol. 138, July 16, 1936, pages 38-42, 114. Considers the high lights of Cr plating as now practiced almost universally, and describes 2 new methods developed in England. One of these developed by Coleman & Appleby, Ltd., and marketed in this country by Nickel & Chromium Products Co., consists in an addition of secret composition to CrO_3 and hot H_2O to produce a plating bath ready for use. Quantity added amounts to about 1/15 of CrO_3 used which must be of high purity. Tank and anodes are made of high-grade antimonial lead but in England glass-lined tanks are generally used. The other English development is brush plating which consists in attaching the negative wire of low voltage d.c. to the work and positive wire to binding post on end of brush which has a metal anode in center. Ni plating can also be done by this method. Thorough cleaning, buffing and polishing are necessary preliminary operations for both processes. VSP (8d)

Nickel and Chromium Plating of Zinc and of Die-Cast Zinc (Nichelatura e Chromatura dello Zinco e dello Zinco fuso sotto Pressione) V. P. Sacchi. *Industria Meccanica*, Vol. 18, June 1936, pages 334-339; July 1936, pages 417-423. Exhaustive review of literature on procedures to obtain good deposits, defects most common in these deposits, properties of deposits from acid and basic plating baths, and stresses occurring in the deposits. 67 references. Ha (8d)

Nickel Anodes (Nickelanoden) E. RAUB. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 10, July 1936, pages 37-43. Scarcity and high price of Ni in Germany make it desirable to use insoluble anodes of either C, Pb or rustless steel in plating baths instead of soluble Ni anodes. However, in baths with high chloride content, the latter 2 materials were strongly attacked; besides, the varying Ni content of the bath due to insoluble anodes is not conducive to good deposits. A satisfactory method, although expensive, uses metallic anodes made by electrolysis of Ni salts. The most suitable anode shapes are discussed which should be as pure as possible. Of the usual impurities, Mg is particularly harmful as it soon leads to disintegration of the anodes in the bath. Fe has no harmful effect on the solubility of the anodes, even in large amounts. The effect of Cu up to 0.2% could not be stated. Zn and Mn can have undesirable effects. The quality of the deposits is not affected by Mg in the bath; it is even of advantage in that it produces soft deposits, so that sometimes Mg salts are added to the electrolyte. Cu is harmful in the bath as it is deposited on the cathode and produces dark deposits; even 0.005 g./l. is obnoxious. Fe also is harmful in the bath. In small amounts it produces finer grain and brighter deposits, but in larger amounts it leads to spalling and scaling. Baths with more than 0.5-1.0% Fe with respect to the Ni content are absolutely useless. Mn has less influence than Cu, but as it accumulates more quickly than Cu, since it is not deposited as quickly as Cu at the cathode, the adhesion of the deposits suffers. Zn in very small amounts produces brighter deposits; in larger amounts, however, dark stripes appear on the deposit. The limit for Zn content should be 0.05-0.1% Zn with reference to Ni. The preferable thickness of plate anodes is 5-8 mm. Cast anodes of less than 5 mm. are produced with difficulty. Ha (8d)

Dry Rectifier Supplies Current for Operating Electroplating Unit. *Steel,* Vol. 98, June 29, 1936, page 46. Describes a rectifier-powered unit for Sn-plating automotive pistons. Size rated at 300 watts will plate 8 pistons at a time with 60 cycle, 110-volt a.c. Rectifiers are of the CuS type, about 12 volts being applied to input side to deliver 6 volts at tank. With continued use it is necessary to apply 13 volts. Plating bath used is of the alkali-Na_2SnO_3 type and is sole supply of Sn. No Sn anodes are used. Replenishing of bath, as indicated by periodic analysis, has been found to be sufficient. MS (8d)

Insulators Salvaged by Cadmium Plating. J. B. BOWEN. *Electrical World,* Vol. 106, Sept. 12, 1936, pages 41-42, 110-112. Corroded caps and pins are reconditioned by Cd plating. CBJ (8d)

Critical Current Density in the Deposition of Chromium (Ueber die kritische Stromdichte bei der Chromabscheidung) N. D. BIRÜKOFF. *Korrosion & Metallschutz,* Vol. 12, July 1936, pages 165-171. In electro deposition of Cr, a definite minimum current density exists below which either practically no Cr is deposited or it appears in spots. This critical current density was investigated in the range, 0°-60° C., and was found to increase with increasing temperature by reason of the increasing velocity of the chemical oxidation of the chromous Cr formed on the cathode whereby only a smaller part of the chromous Cr can be reduced to metal. Additions of small amounts of $K_2Cr_2O_7$, $KHSO_4$, K_2SO_4, $Cr_2(SO_4)_3$, $Cr(OH)_3$ and H_2SO_4 had no appreciable effect on the critical current density whereas $PbCrO_4$ reduced it and chromium-chromate increased it energetically if it had been made by heating aqueous H_2CrO_4 solution or by melting CrO_3. 12 references. Ha (8d)

Nickel-Silver Process (Das Nickel-Silber-Verfahren) H. BEHNKE. *Oberflächentechnik,* Vol. 13, Aug. 18, 1936, pages 183-184. Ni-plated articles are Ag-plated with difficulty as Ag does not adhere very well to Ni. The Ni-Ag process consists in first Ni-plating Cu, brass, or Cu-plated objects in the usual manner and then plating them in a separate bath, the Ni-Ag bath, with a Ag layer. The latter, a KCN-Ni bath containing a small amount of Ag, is a reddish-brown solution made by dissolving 1 kg. of Ni-Ag salt in 8-10 l. H_2O. The Ni-Ag salt consists essentially of Ni-Na-cyanide, NaCN, and AgCN. The bath should have a density of 12° Be and be operated with C anodes. The Ni-plated parts are first treated about ½ min. at 4-5 v. and 3-4 amp./dm.^{2} current density whereby a gray deposit is formed with strong H development. The voltage is then reduced to 2-3 and the parts are left for 2-3 min. further in the bath whereby the deposit becomes gradually lighter and finally has a bright silver-white appearance. If the parts are left in the bath longer than 5 min., the brightness is dulled again. Simultaneous deposition of Ni together with Ag is possible only by keeping the Ag concentration of the bath as low as possible and the voltage as high as possible. Theoretical reasons for this are advanced. Such deposits do not tarnish as easily as pure Ag deposits but without lacquering they are not as tarnish--resistant as an ordinary deposit coated with a good lacquer. 6 references. Ha (8d)

The Diesel Engine in the Plating Plant. C. E. DIETLE. *Metal Industry,* New York, Vol. 34, Sept. 1936, pages 344-345. Diesel engine operation and economy are discussed. CBJ (8d)

Preparation and Protection of Metallic Surfaces (Preparación y protección de superficies metálicas) L. R. DE RIVERA & PUIG D'ASPRER. *Metalurgia y Construcción Mecánica,* Vol. 2, July 1936, page 3; Aug. 1936, page 7. Brief review. FRM (8d)

Defects and Errors in Nickel Plating, Their Causes and Prevention (Die Fehler beim Vernickeln, ihre Ursachen, ihre Abhilfe) A. DARLAY. *Oberflächentechnik,* Vol. 13, Aug. 18, 1936, pages 184-186. Detailed description is given of means and procedures to prevent the baths becoming too alkaline or too acid, streaky deposits, crystallization in the bath, porous deposits, cracks and incorrect thickness of deposits. Ha (8d)

Nickel Plating Brought Up-to-date. GEORGE B. HOGABOOM. *Metal Industry,* New York, Vol. 34, Aug. 1936, pages 298-300. Rule-of-thumb methods have been supplanted by modern methods embodying scientific control and automatic continuous equipment. CBJ (8d)

Testing Plated Products for Quality. SAM TOUR. *Metal Industry,* New York, Vol. 34, June 1936, pages 222-224. Tests for determining the quality of plated products include salt spray corrosion test, ferroxyl test for porosity, bend tests for adherence, and metallographic examination to determine variations in thickness of the deposits and, hence the throwing power of the bath. CBJ (8d)

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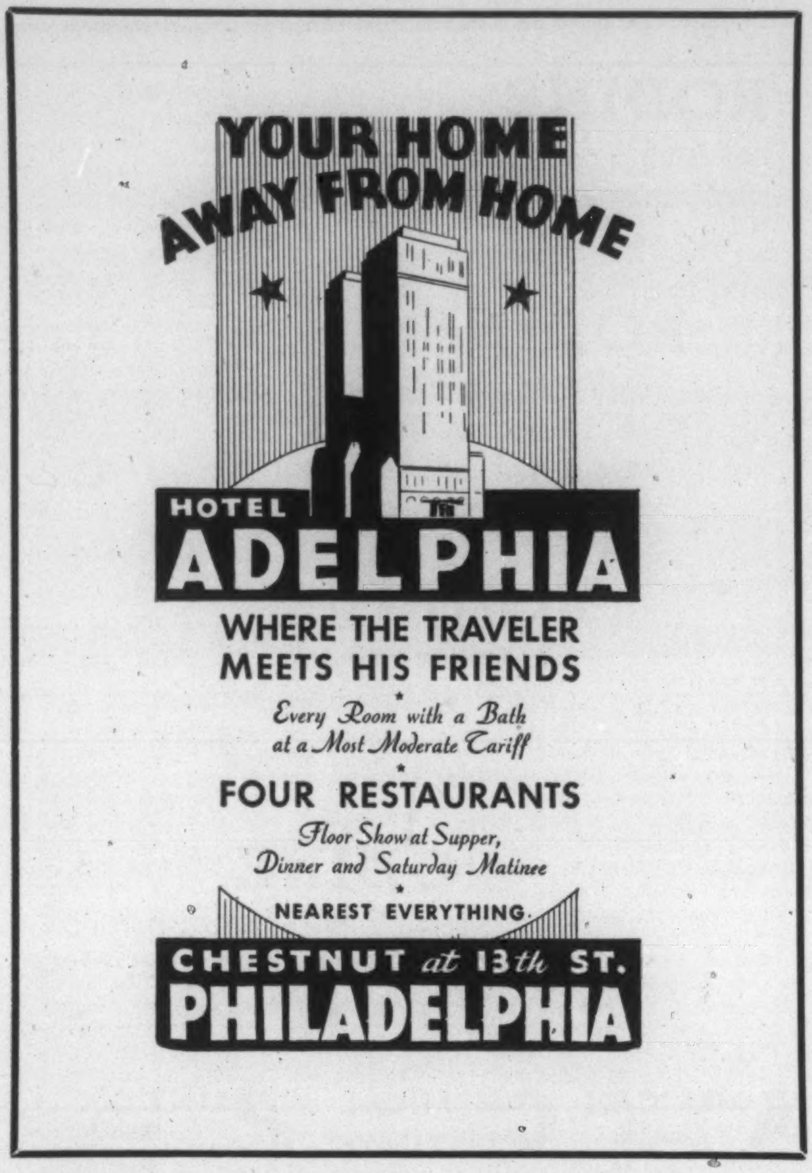
Polarization Potential in the Cathodic Deposition of Zinc from the Aqueous Solution of Zinc Sulfate. T. ISIHARA, T. ONODA & K. UMETU. *Kinzoku no Kenkyu,* Vol. 12, Aug. 1935, pages 381-396. In Japanese. The report is the second on the subject and is concerned with the effect of gelatin and glue added to the acidified solution of $ZnSO_4$. The electrolyte is from 1 to 2 N with respect to $ZnSO_4$ and 0.5 to 1.5 N H_2SO_4, glue or gelatin being added in amounts of 0.025 to 2.0 g./l. The single potential of the cathode, the minimum overvoltage of 0 and the decomposition voltage have been found to decrease with increase in H_2SO_4 concentration and the tendency is greater in the presence of colloids. More complex features are observed in some of the current density-polarization curves. In electrolytes containing glue, polarization is diminished by the addition of acid as long as the current density is low and the amount of colloid is small, while the reverse is the case if the current is high. The discontinuity mentioned in the first report was also observed in electrolytes containing glue at about 0.1 g./l. In case the amount of glue surpasses this limit the current density-polarization curves show abrupt changes in the neighborhood of 60 milliamps/cm.^{2}. The effects of gelatin are somewhat more complex but are smaller. YO (8d)

Standard Quality for Plated Tableware. F. C. MESLE. *Metal Industry,* New York, Vol. 33, Aug. 1935, pages 283-289. Quality marks should indicate the basis metal, the average plate thickness, and its thickness at special wear points. A practical method for measuring the thickness consists in drawing the curved object over a flat file until the Ag is removed and measuring the diameter of the exposed part. The thickness on a flat surface is determined by using a fine abrasive wheel of a known radius and measuring the diameter of the spot exposed by the wheel. CBJ (8d)

Some Properties of Nickel Electrodeposits. ROBERT J. MCKAY. *Metals & Alloys,* Vol. 7, Aug. 1936, pages 193-198. Bath control is discussed under variables of pH, current density, cleanliness of work and bath, temperature, oxidation of evolved H_2 and composition. Thickness of 0.0004" to 0.21875" are obtainable. Greater difficulty is encountered and nicer control is required in producing heavy plates. Brilliancy of finish of the plate is discussed together with effect of additions to the bath for producing a bright finish. Hardness of electroplated Ni can be varied from that of fully annealed metal to a hardness greater than that obtainable by cold work. Ni tends to follow the crystal structure of the basis metal less than other electroplated metals. Adherence depends ordinarily on care in preparation of surface. Throwing power and costs are briefly discussed. 13 references. WLC (8d)

Plating Rhenium and Rhenium-Nickel Alloys. C. B. F. YOUNG. *Metal Industry,* New York, Vol. 34, May 1936, pages 176-177. History and properties of Re are discussed. Pertinent data on Re plating and Re-Rh plating are given. An alloy of Re and Ni has also been plated out. CBJ (8d)

The Bek Process. LOUIS WEISBERG. *Metal Industry,* New York, Vol. 34, Aug. 1936, pages 295-297. Au plating followed by heat treatment to produce diffusion is the basis of a method of jewelry manufacture known as the Bek process. CBJ (8d)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Recent Developments Open Path to Wider Use of Bright Zinc Plating. M. B. Diggin. *Steel,* Vol. 98, Apr. 20, 1936, pages 44, 46. To compete with Cd plating in ease of application, a bright Zn plating process should have the following characteristics (a) produce uniformly bright deposits requiring no bright dip; (b) solutions should be as stable as ordinary cyanide plating baths; (c) bath should operate over reasonably wide range of operating condition, be insensitive to small amounts of impurities, and be capable of control by simple methods of analysis; (d) anode and cathode efficiencies should be balanced, and permissible cathode current density should be high; (e) no insoluble materials should be formed; and (f) deposits should be free from porosity and brittleness, firmly adherent, and should afford as good protection against corrosion as ordinary Zn deposits of same thickness. A process claimed to fulfill these requirements operates at a current density of 40-60 amps, with tank voltage of 3-4 volts. Solution is operated at 75°-110° F. and volume should be such that not more than 2.5 amps./gal. is passed. Special anodes are required, which produce no sludge and do not polarize when left in the solution. Anode area should be about 50% greater than that of cathode. Anode-cathode spacing varies from 7" to 12" and depends on amount of recessing in work. Unlined tanks should be used for solutions. Racks should be made from Cu or brass. Large exposed rack area must be avoided. Tabulates comparative rates of plating of bright Cd and the bright Zn processes. MS (8d)

The pH Number in Electroplating. I. The Measurement of the pH Number in Acid Plating Baths. II. The Measurement of the pH Number in Alkaline Baths (Die pH-Zahl in der Galvanotechnik. I. Die Messung der pH-Zahl in sauren galvanischen Bädern. II. Die Messung der pH-Zahl in alkalischen Bädern) R. Springer. *Oberflächentechnik,* Vol. 13, June 16, 1936, pages 135-136, 149-150. The definition of the pH number as measure of the acidity and amount of H ion concentration is explained, and its importance for electroplating processes and methods for its determination are described. A new indicating paper is mentioned (LWP-PEHA paper) which, similar to litmus paper, indicates by its coloration the acidity. The paper is impregnated with 7 different colors with which is compared the color it assumes on being dipped for 1 sec. into the bath to be measured. The color of the bath itself is compensated. There are 5 kinds of paper at present: a range of 5.2-5.7 pH for ordinary acid Ni baths, 3.7-5.0 pH for acid plating baths (except Zn), 3.7-5.3 pH for acid Zn baths, 1.2-3.4 pH for weakly acid Cu baths (quick plating baths), and 0.9-1.5 pH for acid Cu baths or others with contents of 5-40 g. H_2SO_4/l. Part II. Alkaline bath reaction as expressed by pH > 7 is explained and the possibility of detecting sources of defects in deposits by measuring the pH value discussed and explained by using as examples baths for brass, Cd, and cyanide baths for Cu, Ag and others. PEHA papers are available for these purposes: No. VI, range 9.5-11.0 pH for cyanide Cu, brass and Ag baths, No. VII, range 11.0-13.5 pH for cyanide Cd, tombac, alkaline Zn, alkaline Sn and degreasing baths. The pH value for brass baths should not exceed 10.2 as otherwise the deposits become spotty. Red brass deposits can be obtained by increase of pH to more than 12.5 without having to use a special tombac bath. Practical hints for the use of PEHA paper are given. Ha (8d)

Our Experience in Cadmium Plating in a Barrel. A. F. Fletcher. *Metal Industry,* New York, Vol. 33, Dec. 1935, pages 430-433. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 194R/2. CBJ (8d)

Zinc Plating. C. M. Hoff. *Metal Industry,* New York, Vol. 34, Mar. 1936, pages 99-100; *Aluminium & the Non-ferrous Review,* Vol. 1, May 1936, pages 383-384. Increase in the cost of Cd makes it advisable to extend the use of Zn plating. Properties and plating procedures for these metals are discussed. CBJ + JCC (8d)

Electrodeposition of Tin. A. L. Shields. *Metal Industry,* New York, Vol. 33, Oct. 1935, pages 355-357; Nov. 1935, pages 393-394. See *Metals & Alloys,* Vol. 7, July 1936, page MA 356L/9. CBJ (8d)

Electrogalvanizing of Round Wire. A. Weisselberg. *Iron Age,* Vol. 137, May 21, 1936, pages 34-37, 106; *Metal Industry,* New York, Vol. 34, May 1936, pages 168-172. See *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 453R/8. VSP + CBJ (8d)

Metal Rectifiers to Supply Current for Plating. A. Smart. *Metal Industry,* New York, Vol. 34, July 1936, pages 261-264. Discussion of the principle and construction of metal rectifiers. CBJ (8d)

The Structure of Electrodeposits. D. J. MacNaughtan & A. W. Hothersall. *Metal Cleaning & Finishing,* Vol. 7, June 1935, pages 285-288. Hardness of electrodeposits increases with decreasing grain size. In finer grained deposits, however, large changes in hardness are not accompanied by any considerable change in microstructure. Codeposition of H may affect hardness more than cold working, but it is not controlling. Solution pH, cathode potential, current density also influence hardness although exact relationships were not clear. Colloids or hydroxide precipitates at the cathode are thought to cause small grain size which increases hardness of deposits. A table is given showing Brinell hardness number and some microstructures for 12 different metals: thus Ni (from sulphate solutions) 125 to 420, variation in Brinell number being due primarily to pH changes; Ni (from solution containing colloids) up to 550; Cu (sulphate solutions) 40-62, plus colloids up to 130. See also *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 135L/9. GBH (8d)

8e. Metallic Coatings other than Electroplating

Research on Thin Layers of Tin and Other Metals. II. The Corrosion of Metals by Technical Insulating Oils. P. J. Haringhuizen & D. A. Was. *International Tin Research & Development Council, Technical Publication,* Series A, No. 35, 1936, 16 pages. Very thin layers of Pb, Sn or Cu were deposited on glass by vaporizing the metals in a vacuum. The rate of solution of this metal film in a reagent was determined by noting changes in transmission of light. Transformer oils corrode the metals at different rates, but the rates do not bear a direct relation to the acidity developed in the oils. Some other constituent much smaller in amount than the acid, is assumed to be the active agent. Cu is attacked slowly at first, then much more rapidly. After the first few hundred hours the corrosion of Pb or Sn goes on at constant, very slow, rates with Sn showing more rapid corrosion than Pb in the early stage, but less after the rate becomes constant. Sn would therefore appear suitable for protection of Cu against corrosion in such oils. Sn over Cu was not studied, however, and no comparison was made of the relative corrodibility of ordinary Cu, Ni or Pb as compared with the extremely small crystals in the vacuum-deposited films. HWG (8e)

Casting-on of Metal—A Modern Metal Coating Process (Das Angiessen von Metall—ein neuzeitliches Metallüberzugsverfahren) K. Nischk. *Oberflächentechnik,* Vol. 13, May 19, 1936, pages 111-114. The coating of a metal by casting on another of lower melting point instead of by dipping the object into a bath of the metal is described for Pb on Fe, pure Al on an Al alloy, Zn and bearing metals. Such methods are covered by U. S. patent 1756739, 1870867, 1956466, 1956462, French patents 714180, 785351, English patents 413932, 416371, 428586. Ha (8e)

Defects in Galvanizing (Fehler bei der Verzinkung) Hermann Schörg. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* No. 11, 1934, pages 47-50. Briefly describes steel, pickling practice and Zn bath necessary for successful galvanizing. JLG (8e)

Sprayed Stainless Steel Resists Wear and Corrosion Under Trying Conditions. William C. Reid. *Metallizer,* Midsummer, 1936, pages 6, 10. Tests indicate that corrosion resistance of coatings of sprayed stainless steel increases with fineness of finish. Identical results were secured from 90 hour salt spray tests on rolled sheet stainless steel and on polished sprayed coatings. No composition change takes place in spraying stainless steel. BWG (8e)

Unique Applications. D. R. Redding. *Metallizer,* Midsummer, 1936, pages 7-9. Various applications of metal spraying are discussed, including the spraying with mild steel of valve seats for internal combustion motors, coating with stainless steel the face and stems of large valves, and building up gate valve seats with Tobin Bronze. Mild steel was used to fill an inch hole in a marine gas engine cylinder wall. Corrosion on airplanes was prevented by Al spraying exhaust manifold brackets, grab handles, cable thimbles, links on oil control cables, etc. When a bronze monument sent from Italy to Cuba was found to have 150 ft.^{2} of panels missing, a successful substitution was made by building them of concrete, metal spraying with Pb, then with bronze. BWG (8e)

Galvanizing Kettle Heated by Gas-fired Vertical Alloy Tubes. W. H. Spowers, Jr. *Industrial Gas,* Vol. 15, Aug. 1936, pages 9-10. Cr-Ni tubes in which the fuel is burned at the upper end and from which the combustion products leave at the lower end, were the heating units located within the brickwork of the furnace. The dross by this indirect heating of the galvanizing kettle was only a little over 1% in 5 months. Ha (8e)

Machine Element Spraying Technique. Charles Boyden. *Metallizer,* Midsummer 1936, pages 2-4. Various types of machined threads used in preparing material for metallizing are discussed, the chief requirement being a dragging tool to give a ragged thread. New spraying equipment builds the required coating in one pass. This is said to give a denser coating, require less time and eliminate any chance of layer separation. BWG (8e)

Striations in Tin Coatings on Copper. Bruce Chalmers & W. D. Jones. *Metal Industry,* London, Vol. 47, Dec. 27, 1935, pages 627-629, 635. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 411L/7. HBG (8e)

The Hot-Tinning of Copper: the Attack on the Basis Metal and its Effect. E. J. Daniels. *Technical Publications, International Tin Research & Development Council,* Series A, No. 33, 1936, 11 pages. Reprinted from *Journal Institute of Metals,* Vol. 58, 1936. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 411L/3. (8e)

Origin of Porosity in the Tin Coating of Tinplate. A. W. Hothersall & J. C. Prytherch. *Iron & Coal Trades Review,* Vol. 132, May 8, 1936, pages 849-852. See *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 455L/5. Ha (8e)

Corrosion After Pickling Major Source of Galvanizer's Dross. Wallace G. Imhoff. *Iron Age,* Vol. 138, Aug. 6, 1936, pages 34-37, 95-97. Last of a series of 3 articles; No. 1 and 2, *Iron Age,* Dec. 5, 1935 and Feb. 20, 1936. Deals with reducing action of molten Zn upon roll scale. Test results show: (1) Corrosion after pickling is major source of Fe to form galvanizer's dross; (2) material not fully pickled must remain in galvanizing bath longer, and bath temperature must be higher to break down oxide scale; and (3) dross crystals were produced, showing that Fe from corrosion is the same Fe that is in dross crystals. VSP (8e)

Cementation of Some Metals by Means of Beryllium Powder. Tsutomu Kase. *Kinzoku no Kenkyu,* Vol. 13, May 1936, pages 173-188. In Japanese. By means of pulverized Be the diffusion of Be into Fe, Ni, and Cu at various temperatures between 600° and 1100° C. was investigated. Hardness determinations, measurement of the depth of penetration, microscopic examination and chemical analysis were carried out on the cemented specimens; also corrosion by some acids and oxidation at high temperatures were studied with the following results: Be diffuses into the metals mentioned at a temperature higher than about 600°, and the rate of diffusion increases with rise of temperature. The rate of diffusion into Fe, however, increases more or less abruptly at the A_3 point (906°). The relation between the weight increase of the specimen (ΔW) or the depth of penetration (P) and the absolute temperature of cementation (T) or the time required for the treatment (Θ) is given by an exponential function ΔW (or P) $= ae^{-b/T}$, where a and b are constants. The cemented surfaces are very much harder than the original materials, and some of them show great resistance to atmospheric oxidation and the attack of certain fused salts at high temperatures. The surface of Fe cemented with Be is not easily attacked by concentrated HNO_3, but, in general, the surfaces of the metals cemented with Be show little increase in resistance to corrosion by strong acids. KT (8e)

8f. Non-Metallic Coatings

Testing Metal Finishes. E. A. Fluevog. *Industrial Finishing,* Vol. 12, May 1936, pages 15-16. Paper before the Midwest regional meeting of Paint & Varnish division, American Chemical Society, describes method of testing metal finishes for adhesion and durability when exposed to severe cold, moisture and bending. VSP (8f)

Tank Painting. C. F. Harris, J. I. Nairne. *Journal American Water Works Association,* Vol. 28, May 1936, pages 640-647. Two separate discussions of tank painting with much practical information. VVK (8f)

The Use of the Microscope in the Porcelain Enameling Industry. E. E. Howe. *Better Enameling,* Vol. 7, June 1936, pages 13-16; July 1936, pages 20-22, 29. Microscope is used to study (a) the structure of cast Fe under blisters in the enamel in search for source of trouble, (b) the bonding material in cast Fe enamels, (c) the bond in sheet Fe ground coat enamels, (d) the effect of steel treatment upon the finished coat, and (e) the causes of such phenomena as copperheads, fishscale, blisters, black spots, and hairlines. Preparation of samples is discussed. CBJ (8f)

Metal Casket Finishes. M. Langius. *Industrial Finishing,* Vol. 12, May 1936, pages 40, 42, 44. Discussion of finishing metal caskets, and their various color combinations. Metal caskets, as received, are covered with a thin film of grease or oil to prevent rusting and are cleaned with steel wool dipped in a cleaning fluid, a cheap grade of thinner. Finishing begins with a thin spray coat of non-sanding lacquer primer. Next a color coat is applied which may be one or a combination of colors. VSP (8f)

Synthetic Bake-enamels for Hospital Furniture. Ray C. Martin. *Industrial Finishing,* Vol. 12, Aug. 1936, pages 44, 46, 62-63. Synthetic enamels for metal hospital furniture are of 2 types: phenol-formaldehyde resins and glycerol-phthalate or alkyd materials. Preliminary cleaning of metal surface is of utmost importance. Coatings of synthetic enamels are easily cleaned and lack odor which is important in hospitals. True value of finishes can be determined by tests in sunlight, moisture, chemicals, etc. VSP (8f)

Porcelain Enameling. William J. Miskella. *Metal Industry,* New York, Vol. 34, Mar. 1936, pages 96-98. Description of the dry and wet processes of enameling together with raw materials, composition of enamels and methods of application. CBJ (8f)

Sparton Automobile Horns. J. B. Nealey. *Industrial Finishing,* Vol. 12, Aug. 1936, pages 22, 24, 26, 28. Describes the mass production of automobile horns including automatic handling of parts, metal cleaning, dipping, and spray- and bake-finishing, cooling and assembling. VSP (8f)

Further Data on Enamel Adherence. Karl Kautz. *Journal American Ceramic Society,* Vol. 15, Apr. 1936, pages 93-108. Review of experimental data obtained by author to test theories of enamel adherence, (1) gripping theory: enamel adheres because it fills over the projections and depressions in metal surface, (2) electrolytic theory: displacement by Fe of Co or Ni in ground coat enamel and adherence by gripping and dendrite formation, (3) dendritic theory: Fe crystallized from solution of Fe oxide in glass "spikes" the enamel to the metal plate, (4) oxide layer theory: intermediate oxide layer between metal and glass provides the bond. Tests are described in which "noble" metal surfaces of Cr, Fe-Cr, stainless steels (15% Cr and 18-8) and surfaces of Fe, Ni and Cu were used for enamel adherence studies. The Fe was tested in vacuo and in atmosphere of N_2 but adherence found to be poor, which thus rules out electrochemical displacement as factor in enamel adherence. Discussion of the constitution of Fe scale is given by a review of literature references. Etched and unetched micrographs are shown of enamels fired on Fe and discussions of mechanics of adherence discussed at length from evidence of the micrographs. Simple gripping or mechanical bonding of ground coat enamel to oxidized metal surface does not exist. For noble metals where no oxidized surface exists the weak adherence found can be explained on basis of simple gripping. No evidence of electrochemical basis for adherence was found nor for dendrite explanation of adherence. It is concluded that adherence is due to a film of ferrous phase about 3" x 10^{-5} thick which is intermediate between the enamel and Fe surface. WB (8f)

Development of Sand Abrasion Machine. G. H. Spencer-Strong. *Journal American Ceramic Society,* Vol. 19, Apr. 1936, pages 112-115. Machine for testing abrasion resistance of enamels by means of sand blast is described and results discussed and shown in tables. WB (8f)

Reviewing Some Pertinent Facts Concerning Aluminum Paint. *Steel,* Vol. 98, June 1, 1936, page 42. Best vehicle is high-bake varnish or synthetic vehicle although good spar varnish will produce a satisfactory finish. For indoor finishes, good grade of clear lacquer should be used. Maximum of 1½ lbs. and minimum of 1¼ lbs. of Al powder per gal. of vehicle should be used. Al pastes have several advantages over dry powder. Although inhibitors have been developed to prevent loss of leafing powder, it is advisable to mix fresh batches daily. Al paints can be tinted to obtain pleasing effects. MS (8f)

"Plicote"—Corrosive Proof Protective Coating. *Industrial Finishing,* Vol. 12, May 1936, pages 56, 58. Describes a new protective paint-like covering for metal, concrete, wood, etc. Contains resin composed principally of rubber hydrocarbon derived from best grade of rubber. It is said to be effective in resisting acids, alkalies, brines, oils and greases. Developed by Watson-Standard Co., Pittsburgh. VSP (8f)

Applying Wet Process Ground Coat Enamels. *Better Enameling,* Vol. 6, Oct. 1935, pages 20-21, 30. Wet process enamel is applied to cast Fe by spraying. Ground coat is applied to sheet metal by dipping and draining or by slushing; large pieces such as sign work may be sprayed. Equipment and control methods are discussed. CBJ (8f)

Spraying Finish Coat Cast Iron Enamel. *Better Enameling,* Vol. 6, Dec. 1935, pages 12-14. Equipment and procedure of applying the finish coat of enamel to cast Fe objects are discussed. CBJ (8f)

Selecting the Sheet Metal and Designing the Product for Enameling. *Better Enameling,* Vol. 6, May 1935, pages 15-19. Enameling difficulties can be avoided by proper selection of sheet metal. Unsuitable metal may lead to copper-heads or dark red-brown spots, blisters, and warping. Selection of proper gage is as important as the quality. Factors in designing the product and forming operations used are described. CBJ (8f)

Cast Iron and Designing Cast Iron Parts for Enameling. *Better Enameling,* Vol. 6, June 1935, pages 15-18, 26. 3 factors which determine the quality of a cast Fe base to be enameled are design of the casting, composition, and foundry practice. In discussing these factors, 4 typical compositions are given. CBJ (8f)

Firing Wet Process Cast Iron Enamel. *Better Enameling,* Vol. 7, Apr. 1936, pages 17-20. Drying, firing practice, and equipment are discussed. CBJ (8f)

Firing Sheet Steel Enamel. *Better Enameling,* Vol. 7, May 1936, pages 21-22, 30. Drying, brushing, firing, and equipment used are described. CBJ (8f)

Thiokol—A New Material Finds Aircraft Uses. *Aero Digest,* Vol. 29, July 1936, pages 29, 110. Synthetic rubber material used for covering metals, etc., has resistance to oil, gasoline, chemicals and oxidizing atmosphere. WB (8f)

The Pylumin Process for the Protection of Aluminium. Pyrene Co. Ltd. *Aluminium & the Non Ferrous Review,* Vol. 1, June 1936, pages 434-436. The process consists in immersing Al for 3-10 minutes in a boiling solution of "Pylumin" powder (composition not stated). The protective coating thereby produced is one to which paints and lacquers adhere firmly. JCC (8f)

The Finishing of Small Objects by the Tumbling Process. *Aluminium & the Non Ferrous Review,* Vol. 1, June 1936, page 443. Small articles may be finished by tumbling in a barrel with the cautious addition of small amounts of lacquer. JCC (8f)

Dip Finishing with Special Equipment. Louis Bodor. *Industrial Finishing,* Vol. 12, June 1936, pages 30, 32. Description of equipment used in finishing various articles by dipping. Important points to consider are: Speed of dipping; angle of dipping; correct dipping fixtures; viscosity of material; and proper drying method. Gives several examples. VSP (8f)

Coloring of Metals. Herbert R. Simonds & C. B. Young. *Iron Age,* Vol. 137, Mar. 26, 1936, pages 48-53; Apr. 16, 1936, pages 25-30; June 18, 1936, pages 30-33, 99. Describes the principal commercial developments in coloring Fe and steel, white metals, Cu and brass, Zn and the cost of metal coloring. Includes results of some recent researches and a description of new method of metal coloring by electrolysis. VSP (8f)

9. TESTING

9a. Inspection & Defects, including X-Ray Inspection

C. S. BARRETT, SECTION EDITOR

Causes for the Formation of Flakes in Cr-Ni-Mo Steels (Sulle cause della formazione dei fiocchi negli acciai al cromo-nickel-molibdeno) I. MUSATTI & A. REGGIORI. *La Metallurgia Italiana,* Vol. 28, May 1936, pages 197-218. See *Metals & Alloys,* Vol. 7, Apr. 1936, page MA 197L/5. AWC (9a)

Magnaflux Inspection Methods in Airplane Engines. H. J. NOBLE. *Metals & Alloys,* Vol. 7, July 1936, pages 167-170. Describes method of locating defects in magnetized steel or its alloys by means of a finely divided paramagnetic material. The material may be dusted on the magnetized piece under test or the piece immersed in a kerosene suspension of the material. Defects discoverable and application of method to airplane parts are discussed. WLC (9a)

X-rays and Arc Welding (Les Rayons X et la Soudure à l'Arc) F. GRÉBERT. *Arts-et-Métiers,* Vol. 89, May 1936, pages 107-110. Explains the stereoscopic method for determining position and size of inside defects and gives typical examples of defects: blow-holes, slag inclusions, cracks. FR (9a)

Failure of Locomotive Parts. F. H. WILLIAMS. *Railway Mechanical Engineer,* Vol. 110, May 1936, pages 190-192; June 1936, pages 249-251. Incorrect shape, sharp corners and poor machining are often found to be the cause of failures of side-rods. Examples are described in illustration. Ha (9a)

New Advances in X-ray Diffraction Applications in Chemical Plants (Neue Fortschritte der Feinstrukturuntersuchung durch Röntgenröhren in ihrer Bedeutung für den Bau chemischer Apparate) A. KARSTEN. *Chemische Apparatur,* Vol. 23, May 1936, page 26. Description of new portable instruments of small size and high efficiency, fully safeguarded against high tension and radiation. Their application for the detection of corrosion, wear, and recrystallization of materials is discussed. HR (9a)

Heat Treated Bridge Wire Failures Reproduced in Tests. *Engineering News-Record,* Vol. 117, Aug. 13, 1936, pages 217-221. Investigation by the Bureau of Standards of wire removed from Mt. Hope bridge indicates inability of crystalline micro-structure to resist fatigue fracture under fluctuating tensile loads as the cause of failure. CBJ (9a)

Bridge Wire Tests Leave Some Questions Unanswered. E. E. THUM. *Engineering News-Record,* Vol. 117, Aug. 13, 1936, pages 221-223. Bureau of Standards Report on bridge wire failure is analyzed. Author suggests further study necessary. CBJ (9a)

Detecting Defects in Ferromagnetic Materials by the Use of Filings (Fehlernachweis in ferromagnetischen Werkstoffen nach dem Feilspäneverfahren) JOHANNES KRAUSE. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* No. 16, 1935, 54 pages. Describes experiments to determine the suitability of Fe powder held in suspension and applied to a magnetized part for determining defects. The method is not very suitable for parts of very irregular section and for heavy parts. It is very successful in locating defects in small parts of not too irregular section. In heavy parts small defects near the surface are shown while much larger defects near the core are not shown. Results obtained with welds are difficult to interpret. The method is suitable for detecting defects in semi-finished parts such as bolts prior to threading and for locating hardening cracks. JLG (9a)

Methods for Determining the Thickness of Zinc Coatings. WALTER R. MEYER. *Metal Industry,* New York, Vol. 34, May 1936, pages 173-175. The Hull-Strausser drop test, Sb chloride-HCl strip measurement, microscopic measurement, and analytical measurements give reliable and correlated results when used on electrogalvanized Zn coatings. The Preece test has too large a percentage error for measurement of deposits less than 0.001″ thick. The stripping-analytical method is most reliable for determining the weight of Zn in sherardized coatings. The Preece test gives very unreliable results for sherardized coatings. The most reliable method for determining the amount of Zn in hot-galvanized coatings is the stripping-analytical method. The accuracy of the Preece test, microscopic measurement, and the Sb chloride-HCl strip test varies with the ratio of alloyed Zn to free Zn. The Preece test and microscopic measurement are valuable in determining the distribution of the Zn coatings. CBJ (9a)

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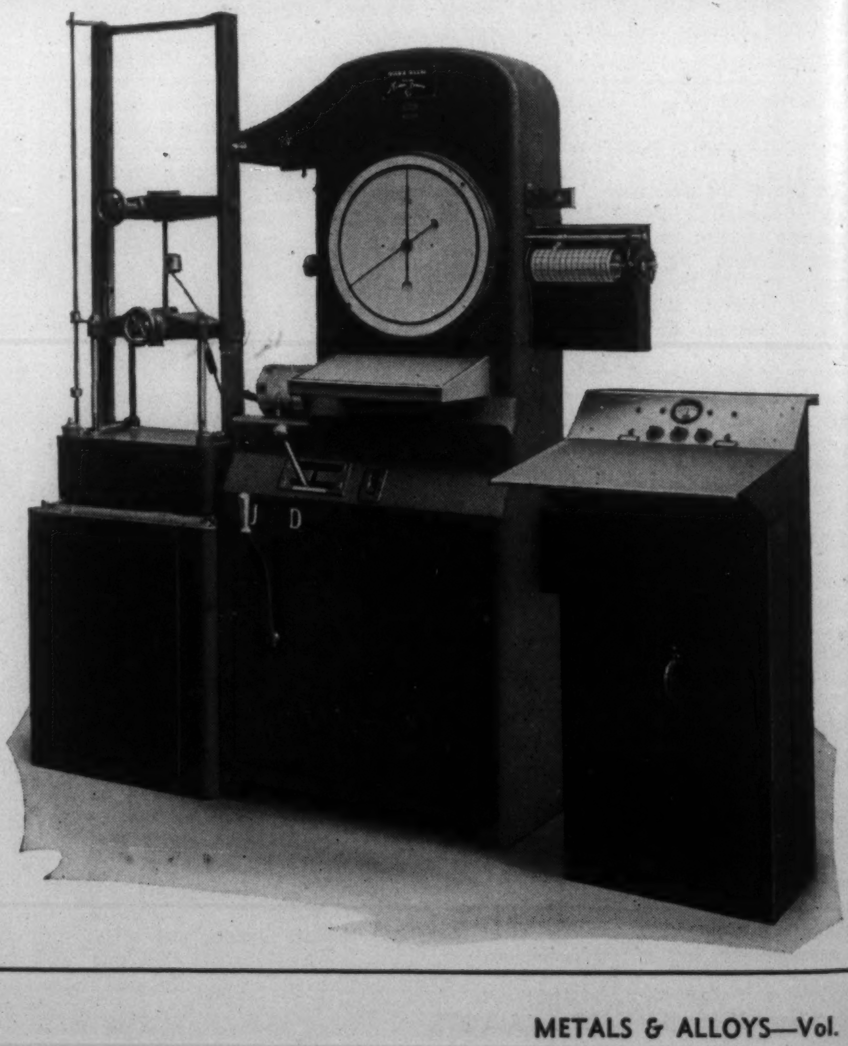


9b. Physical & Mechanical Testing

W. A. TUCKER, SECTION EDITOR

Torsion Measuring Apparatus Bamag (Le torsiomètre Bamag) ANDRÉ TENOT. *Génie Civil,* Vol. 108, Feb. 8, 1936, pages 141-142. Mechanics of the apparatus containing stroboscopic features are described. JDG (9b)

A Research into Tests for Materials used in Cold Pressing Operations, with Special Reference to the Fluid-pressure Cupping Test. H. J. GOUGH & G. A. HANKINS. *Journal Royal Aeronautical Society,* Vol. 39, Nov. 1935, pages 1047-1075; discussion page 1092. Paper read at a joint meeting of the Royal Aeronautical Society, the Institution of Automobile Engineers and other groups. Some of the mechanical tests often employed for sheet metal are examined critically, with particular attention to the investigation and development of a new form of cupping test. Materials for cold-pressing operations can not be qualified by a simple test owing to the plastic rather than the elastic nature of such operations. Strain hardening following plastic deformation is also difficult to allow for, owing to the time element in the recovery, wholly or partly, of elasticity. Attempts to specify suitable material are based on combinations of tensile strength, chemical composition, and microstructure data. The cupping tests in use serve to distinguish absolutely unsuitable materials from the rest, but are unable to grade as fair or perfect those that pass the test. The outstanding deficiency of the usual cupping test is the use of a distending tool. In the cupping test developed by the author deformation is accomplished by applying fluid pressure to one side of the sheet, forming the latter into a dome. Results with the new test are compared with those obtained by the usual cupping tests and with tensile strength data for a large number of standard and miscellaneous sheet materials. FPP (9b)

Notch-Impact Toughness (Zur Frage der Kerbschlagzähigkeit) M. MOSER. *Zwanglose Mitteilungen des deutschen und oesterreichischen Verbandes für die Materialprüfungen der Technik,* No. 28, May 1936, pages 412-413. A discussion on current practice and the suitability of the Charpy test. No change in present rules seems desirable. Ha (9b)

Testing Cast Iron Using Cylindrical Test Pieces 5.64 mm. Diameter (L'essai des fontes sur l'eprouvette cylindrique de 5.64 mm de diametre). PIERRE NICOLAU. *Revue de Métallurgie,* Vol. 33, May 1936, pages 348-352; June 1936, pages 393-399. Recommends testing properties of cast Fe using a test piece 5.64 mm. diameter. Gives description of F. Eugene machine for testing hardness, shear strength, compression and bending on these specimens as well as of an apparatus proposed by the author for alternating impact testing. JDG (9b)

9c. Fatigue Testing

H. F. MOORE, SECTION EDITOR

The abstracts appearing under this heading are prepared in cooperation with the A.S.T.M. Research Committee on Fatigue of Metals. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

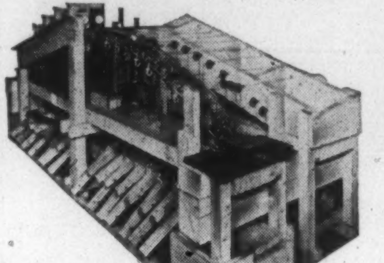
Endurance and Damping of Commercial Steels and Copper and the Effect of Cold Riveting (Die Schwingungsfestigkeit und Dämpfungsfähigkeit von handelsüblichen Stählen und Kupfer und ihre Beeinflussung durch Kaltnietung). *Mitteilungen des Wöhler Instituts,* Heft 28, 1936, 87 pages. This work was carried on upon Armco Fe and 3 commercial grades of steel classed under German specifications as Nos. 34, 37 and 50, i.e., of 48,500, 52,500 and 71,000 lbs./in.^{2} minimum tensile strength. Different lots of No. 37 were used, ranging from 0.05 to 0.12% C and from 54,000 tensile 30% elongation to 63,000, 22%, in different gages. Under similar test conditions the damping power of the different lots varied as much as 8 to 10 times. The author does not relate these differences to finishing temperatures in rolling or to degree of reduction. With such variations in materials tested, generalizations from his data would be difficult to draw; and instead he describes each particular test in great detail. Part of the work is an extension of the studies of Appenrodt (Heft 24) on damping at room temperature and at 120° C., in which the endurance limit of specimens of the material under test is estimated by running 2 million cycles, raising the stress 10%, running another 2 million, and so on, from which an approximate endurance limit for material thus strengthened by understressing, is estimated. The damping tests are then made at a load of 25% under, for room temperature and 30% under, for 120° C. the estimated endurance limits. The damping curves are taken as received, after 50,000, ¼ million, 1¼ million, 6¼ million and 31¼ million cycles. At room temperature the various steels increase in damping power to a maximum somewhere around 1¼ to 6¼ million and then decrease, but do not come clear back to the starting point, while at 120° C. the damping increases all the time. Cu was not studied in this phase of the work. Endurance and damping tests were made on solid specimens of Cu, Armco and No. 34 steel, and on other specimens made by riveting together two pieces of stock each half the thickness of the solid specimen being compared. As would be expected, the endurance limits of the riveted assemblies were lower and the damping higher than in the solid specimens, and the result showed considerable scatter. Fatigue failure did not always start at a rivet hole, but sometimes at the edge of a rivet head, or at a point in the interior of the riveted assembly where the 2 halves rubbed together. Photos of the fractures are shown. HWG (9c)

Leadership
in TESTING
methods and equipment

●

In the movement towards weight reduction in vehicles and toward the study of stress distribution in pressure vessels, reinforced concrete arches, suspension bridges, etc.—strain gauging of structures has contributed greatly.

The analysis by models prior to the construction of the main structure, and tests to destruction of a full sized structure scheduled for abandonment have been employed to aid these studies.



● In Model Studies

Professor Beggs of Princeton has done much, his work including models of the towers of the Golden Gate Bridge constructed to exact scale in stainless steel; and a model of the world's largest floating drydock.

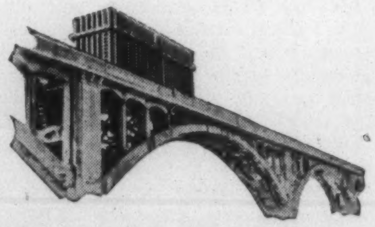
The Aluminum Company of America and the Bureau of Reclamation have studied models of dams, prior to actual construction followed by comparisons with the prototype.

Professor Large at Ohio State College has made studies of a skyscraper model. The U. S. Experimental Model Basin uses ship models for study. The Port of New York authority have studied models of the George Washington and Bayonne Bridges.

Other bridge structures such as the San Francisco-Oakland Bay Bridge have been studied in models.

Models have been made in celluloid, rubber compound, wires, stainless steel sheet—and the stress analysis made with dial gauges and very notably with Huggenberger Extensometers. (See illustration.)

Professor Beggs has attacked model studies from another angle—with the use of the Deformeter Gauges, wherein celluloid models are studied in two dimensions by introducing known deformations instead of loads, utilizing Maxwell's theorem and reading deflections with microscopes. Among many such uses was the study of the overhead system during the electrification of the Illinois Central Railroad at Chicago.



● Full Scale Tests

to destruction, or planned destruction, have been made on such structures as the Stevenson Creek Arch Dam and the Yadkin River Bridge. This latter was a full sized highway bridge. On these structures, the Electric Telemeter was used and in the dam test the Whittemore Strain Gauge came into use—a gauge in which the best reproducibility of readings was obtained.

The use of the Whittemore Strain Gauge has spread rapidly for stress analysis in the field. It was used on the Sidney Harbor Bridge by Dr. Bradfield, and is in use for such similar work as done by the American Bridge Company. It is used for arch tests, such as were conducted at the University of Illinois and Lehigh University, and in most of the major analyses of recent years.

Likewise, the rapid developments in aviation, automotive and railway equipment have advanced to an important place, the use of the Huggenberger Extensometer, the Scratch Recorder (for dynamic as well as static measurement), the Whittemore Strain Gauge and the electric recording instruments for stress studies, both under static loading and in reproductions of service conditions in live loading.

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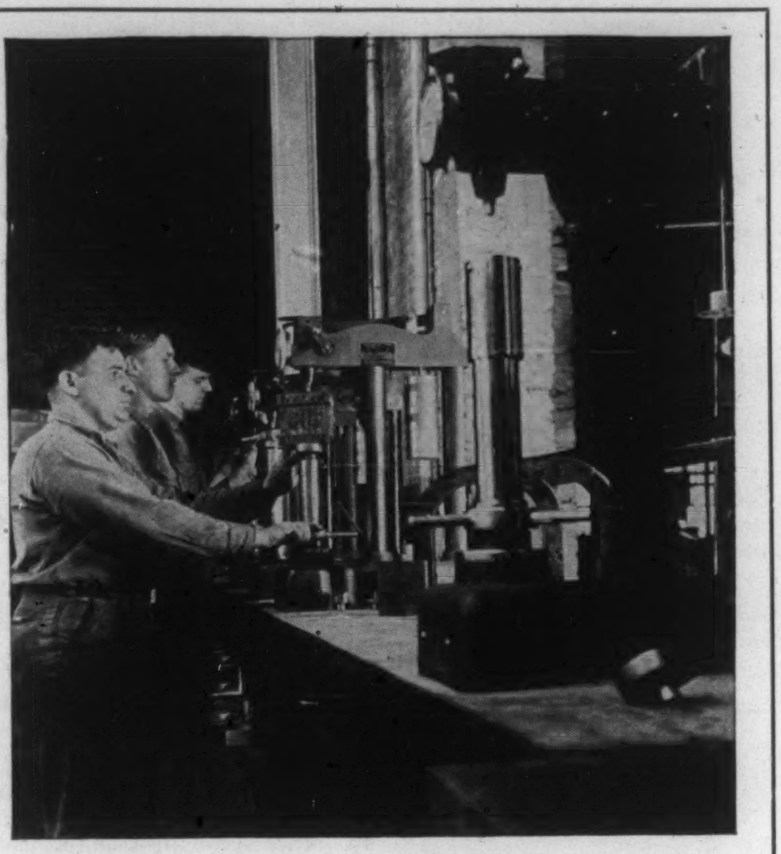

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The Rate of Growth of Fatigue Cracks. A. V. de Forest. *Journal of Applied Mechanics,* Vol. 3, Mar. 1936, pages A23-A25. The resistance of metals to the propagation of cracks is discussed; it is found that the usual fatigue test results are not conclusive if no distinction is made between repeated stresses required to start cracks and stresses to propagate the cracks to failure. 2 items are important: (1) stress and cycles required to start a fatigue crack and (2) stress and cycles required to propagate the crack to failure. The first is greatly affected by surface conditions while the second is dependent on the metallurgical condition of the metal. (Note by H. F. M.: Fatigue tests on car axle steel and rail steel indicate that the stress necessary to propagate a crack may be as low as 50% of the stress necessary to start it.) 5 references. Ha (9c)

Fatigue Properties of Nitrided Steel. H. Sutton. *Metal Treatment,* Vol. 2, Summer 1936, pages 89-92. Wöhler tests made on nitrided test pieces and on specimens cut from the core of a larger nitrided bar of the same nitralloy steel confirmed earlier conclusions that nitriding produces an increase of 20-40% in the fatigue limit under reversed bending. Tests in a Haigh machine, however, showed that no appreciable improvement was produced under reversed direct stresses. In the Wöhler tests, failure commences at a point near the junction of case and core; and in these conditions surface defects and notches have, as might be expected, little influence on the fatigue strength. (Note by H. F. M.: The different behavior in the cases of flexure tests and tension tests may be explained by the fact that in flexure tests the nitrided metal at the surface is in a position to resist the highest bending stress; in the tension tests all the cross section is subjected to equal stress and nitriding is less effective as a stress raiser.) JCC (9c)

Two- and Three-Dimensional Cases of Stress Concentration, and Comparison with Fatigue Tests. R. E. Peterson & A. M. Wahl. *Journal of Applied Mechanics,* Vol. 3, Mar. 1936, pages A15-A22. A determination of stress-concentration factors shows that in some cases practical fatigue results are quite close to theoretical values, and that fatigue results for alloy steels and quenched C steels are usually closer to theoretical values than are the corresponding fatigue results for unquenched C steels. The size of the specimen has some influence on the test results, sensitivity factors from small specimens should not be applied indiscriminately to machine parts. 18 references. Ha (9c)

Study of Fatigue Strength of Welds (Etude de la résistance à la fatigue des soudures à franc-bord) H. D. Dutilleul. *Génie Civil,* Vol. 108, Jan. 11, 1936, pages 62-64. Fatigue testing machine is described in which sockets are provided on both ends of the shaft of a high speed motor into which tapered test specimens are screwed. The latter are loaded on cantilever principle by weights supported by roller bearings. Properties of some welds were determined on specimens prepared from samples cut across the bead. JDG (9c)

Internal Stresses and Fatigue Resistance of Spring Steels. M. L. Becker & C. E. Phillips. *Iron & Coal Trades Review,* Vol. 132, May 8, 1936, pages 846-849; *Heat Treating & Forging,* Vol. 22, May 1936, pages 227-232, 240. See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 412R/4. Ha + MS (9c)

Further Experiments on the Effect of Surface Conditions on the Fatigue Resistance of Steels. G. A. Hankins, M. L. Becker & H. R. Mills. *Iron & Steel Institute,* Advance Copy No. 8, May 1936, 27 pages. The investigation was carried out as a continuation of work on fatigue resistance of unmachined steels. Results of fatigue tests on 2 steels are reported, the work being done to determine the influence of decarburization and surface irregularity both together and singly. An attempt was made to improve fatigue resistance of such steels by recarburization. Tests were made on unmachined steel forgings having a tensile strength in excess of 224,000 lb./in.^{2} Some results are given on fatigue tests of unmachined mild steels. It is concluded that the combination of surface irregularities or inclusions and decarburization is the major cause of the low fatigue resistance of unmachined spring steels. Surface recarburization of decarburized steels was found to increase fatigue resistance in some cases, but such treatment is not recommended in commercial operations. The effect of unmachined surface on very high tensile forgings is very marked, the endurance limit being less than half that for machined steel. It is concluded that the effect of unmachined surface on the fatigue strength of mild steel is not important, although exceptions may occur. JLG (9c)

■ 9d. Magnetic Testing ■

The Ferromagnetism of Nickel. I, II. Temperature Effects. J. C. Slater. *Physical Review,* Vol. 49, Apr. 1936, pages 537-545; June 1936, pages 931-937. By using metallic energy levels extrapolated from Cu to Ni, the energy difference between a nonmagnetic and a ferromagnetic state with permanent magnetic moment is calculated for Ni, and it is shown that the ferromagnetic state is the stable one. Both saturation magnetic moment and Curie point are calculated, in agreement with experiment within the limits of error of the calculation. Extrapolation further into the Fe group, though less justified than to Ni, indicates that ferromagnetism should persist in that group down approximately to Fe. The criterion for ferromagnetism previously suggested by the author, the existence of inner unfilled electron shells (the 3d), small in proportion to their distance apart, is justified. The calculation is not made according to Heisenberg's method, which is considered to be unsuitable for application to ferromagnetism, except in its general principle of explaining the energy of orientation of elementary magnets in terms of exchange energy. Part II. The temperature variation of the ferromagnetism of Ni is discussed. The free energy is computed as a function of temperature and magnetic moment. At each temperature, the value of magnetic moment for which the free energy is a minimum is the value which will actually be found, and this decreases with increasing temperature, going to zero at the Curie point, in satisfactory agreement with experiment. The value of the free energy itself at the minimum, as a function of temperature, is compared with experimental values derived from the observed electronic specific of Ni, and the agreement is again satisfactory. It is found that even at the absolute zero not quite all of the spins are parallel to each other, the minimum in the free energy curve coming at a little less than the maximum possible magnetic moment. It is suggested that this small effect becomes much more pronounced as Fe is approached in the series of ferromagnetic elements, explaining the fact that alloys of Fe and Co show the highest saturation moments of any ferromagnetic substances, the moment then decreasing in Fe and even more in alloys of Fe with lighter elements. WAT (9d)

■ 9e. Spectrography ■

L. W. STROCK, SECTION EDITOR

Electronic Microscope (Le Microscope électronique) J. R. Maréchal. *Revue Universelle des Mines,* Vol. 12, Aug. 1936, pages 325-330. Theory of the electron microscope and the high separation power which it has attained now by the use of monochromatic ultraviolet light and objectives of naphthalene monobromide, is explained and examples of structures obtained with it shown in photographs. 14 references. Ha (9e)

Quantitative Spectroscopic Determination of Antimony in Copper (Quantitative Spektralanalytische Bestimmung von Antimon in Kupfer) B. A. Lomakin & A. L. Ostaschewskaja. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 228, July 14, 1936, pages 44-48. WB (9e)

New X-Ray Spectroscopic Method for the Chemical Analysis of Polished Sections (Eine neue röntgenspektroskopische Methode zur chemischen Analyse von Anschliffen) L. v. Hamos. *Metallwirtschaft,* Vol. 15, May 8, 1936, pages 433-436. A plane surface of the specimen to be analyzed is exposed to primary X-rays, whose reflections are screened from the film. The secondary X-rays emitted from the specimen are diffracted from a bent crystal onto the film. Since the wave length of these secondary rays is characteristic of the material, the positions of spots on the film show the chemical components of the specimen. The fine structure and intensity of any individual film spot shows the distribution of that particular element in the portion of the sample exposed. Typical photographs are shown. GD (9e)

Isotopic Constitution of Lead from Hyperfine Structure. John L. Rose & R. K. Stranathan. *Physical Review,* Vol. 49, June 1936, pages 916-920. The relative abundance of the isotopes of Pb was determined from intensity measurements of the hyperfine structure components of the Pb spark line λ5372. With 11 calibrated wire screens a single order of the Fabry-Perot interference pattern was photographed with the same exposure time for each screen. The following results from densitometer measurements were obtained for the percentage abundance of the isotopes of ordinary Pb: 51.5, 26.3, 21.4, and 0.8 for Pb^{208}, Pb^{206}, Pb^{207}, and Pb^{204}, respectively. For integral masses of the isotopes the mean mass number is 207.22_8. Assuming a packing factor of +1, this number when converted to the chemical atomic weight scale becomes 207.20. WAT (9e)

The Strength of Metals under Combined Alternating Stresses. H. J. Gough & H. V. Pollard. *Proceedings Institution of Mechanical Engineers,* Vol. 131, Oct.-Dec. 1935, pages 3-103. Includes discussion. See *Metals & Alloys,* Vol. 7, Jan. 1936, page MA 25R/2. Ha (9e)

10. METALLOGRAPHY

J. S. MARSH, SECTION EDITOR

Analysis of Materials by the X-ray Diffraction Method. H. R. Isenburger. *Product Engineering,* Vol. 7, May 1936, pages 177-179; July 1936, pages 264-266. Elementary. Ha (10)

An Electron Microscope for Filaments: Emission and Adsorption by Tungsten Single Crystals. R. P. Johnson & W. Shockley. *Physical Review,* Vol. 49, Mar. 1936, pages 436-440. A new and simple electron microscope has been designed for small cylindrical filaments. Die marks are found to be prominent in the electron images of all drawn wires. The activation of thoriated W has been studied. Electron emission from single crystals grown in drawn pure W filaments varies around the wire circumference and depends systematically on crystallographic direction. This variation of emission with crystallographic direction is more pronounced and complex when the filament is allowed to self-activate in Cs or K vapor. WAT (10)

A Novelty in the Field of Material Testing and Its Importance in Foundry Practice (Eine Neuerung auf dem Gebiete werkstoffkundlicher Prüfverfahren und ihre Bedeutung in der Giessereipraxis). A. Karsten. *Giesserei,* Vol. 23, May 22, 1936, pages 265-268. New microphotographic instruments are described. Ha (10)

Isothermal Transformation of Austenite. S. A. Kazeev. *Metallurg,* Vol. 11, June 1936, pages 43-54. In Russian. Amount of austenite which decomposes during interval *t* is equal to $A = 100e^{-at^{n}}$, expressed in percentage. This expression corresponds to a straight line in logarithmic coordinates. Data obtained by F. Wever & W. Jellinghaus (*Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 13, 1933) closely arrange themselves along these straight lines, the equation becoming $A = 100e^{-0.001555t^{2.475}}$. It remains valid when decomposition forms only cementite and ferrite. When it results in martensite, the straight line has a break in it; for 185° C. and 0.89% C steel, it occurs at 120 minutes. During the first 120 minutes the reaction proceeds according to $A = 100e^{-0.00334t^{1.008}}$ and after this period according to $A = 100e^{-0.0956t^{0.808}}$. Process of decomposition in 2 stages does not always take place continuously. The second stage begins sometimes only after a certain lapse of time during which transformation either does not occur at all or proceeds slowly. As a rule, this situation is observed on undercooled austenites, the lower the temperature the more austenite is decomposed during the first stage and less during the second. Austenite decomposition rate continuously changes during the process and can be represented by the following derivative of the above equation: $v_{max} = 100k^{k}a^{1-k}n\,e^{-k}$. Applied to 1.07%C, 1.52 Cr and to 0.95% C steels the above formula indicates that the maximum transformation rate corresponds to a moment at which austenite content is 55-60%. Time required for complete decomposition is about 2.5 times as long as is necessary to reach the maximum transformation speed; *i.e.,* the average transformation rate before reaching the maximum is greater than after it. Time required to produce a 99% decomposition can be expressed by $t_n = \sqrt[n]{\frac{4.6051}{a}}$, so that for the half decomposition often mentioned in literature it will be $t_{50} = \sqrt[n]{\frac{0.693}{a}}$. Plotting C content against maximum transformation speed of austenite in %/sec. showed that C stabilizes austenite. Data obtained by Davenport and Bain for a 1.17% C steel were used for determination of maximum transformation speed as a function of quenching temperature. The curve consists of 2 straight lines intersecting at an angle corresponding to 955° C. Raising temperature from 843° to 955° C. pronouncedly stabilizes austenite, but above this range the influence of temperature is much less efficient. At 955° C. all cementite is in solution and further heating might only cause some local concentration of the element. Heating under 955° C. is 18 times more efficient for stabilization than above it. The curves used for calculations were given by the above authors to demonstrate stability of austenite as a function of grain size, but calculations show that they fail to do so because grain size is a continuous function of temperature, and intersection at 955° C. could not occur were the curves to represent grain size alone. With considerable undercooling austenite transforms in 2 stages, the first of which is more intense than the second. The classical S-curve in its lower part is a function of cooling conditions used in experimentation, with variations of which the corresponding portion of the curve will change also. The first stage is induced by internal strains in the metal. When they are reduced by slipping to a greater or lesser extent, further transformations of austenite take place in the regular order. (10)

On "Somatoid" Elements of Structure in Electrolytic Metal Deposits. V. Kohlschütter. *Transactions Faraday Society,* Vol. 31, Sept. 1935, pages 1181-1188. Discussion on page 1218. "Somatoids" are small independent particles, mostly of crystalline structure, which possess characteristic shape, but which are essentially different from true perfect, or only partly developed crystals. The internal structure of "somatoid" is not homogeneous but the material is distributed in them in a characteristic fashion which determines their outward appearance. "Somatoids" are almost always products of a compound action of crystallization forces with surface forces forming mobile masses. Spherical drops and normal shaped crystals are the two extremes. The mechanism of the formation of "somatoids" in electrolytic deposition is discussed at length. 6 references. PRK (10)

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1 **Primary Crystallization of Metals.** F. R. HENSEL. *Blast Furnace & Steel Plant,* Vol. 24, Feb. 1936, pages 145-148; Mar. 1936, pages 231-234. Paper read before the Detroit Foundrymen's Association, Oct. 17, 1935. After discussing theories adopted for explaining ingot structure, and listing metallurgical factors affecting primary structure, describes investigation of primary crystallization during solidification. MS (10)

2 **Relation of Mechanical Properties of Cast Iron to Structure (Ueber den Zusammenhang der mechanischen Eigenschaften des Gusseisens mit der Gefügeform)** G. MEYERSBERG. *Giesserei,* Vol. 23, June 5, 1936, pages 285-290; June 19, 1936, pages 315-320. Mechanics of fracture of cast Fe is discussed and the difference between that of steel and of cast Fe explained; in the latter, not the tensile strength, but the separating strength determines the fracture. The graphite inclusions exert a certain reducing effect, which determines the character of the fracture in cast Fe; this "contraction factor" is defined as $e = E_s/E_c$, where E = the elastic modulus and the indices s and c designate steel and cast Fe. The higher e, the more the tensile strength is reduced. In a similar manner also the notch effect of graphite inclusions and distribution is taken into account. A 3-dimensional diagram gives the numerical values for relations between tensile strength, separating strength, and contraction factor. 12 references. Ha (10)

3 **On the Mechanism of Transformation of Face Centered Cubic into Hexagonal Close-packed Lattice.** ZENJI NISHIYAMA. *Science Reports Tohoku Imperial University,* Vol. 25, Apr. 1936, pages 79-93. This transformation was studied with an alloy of 70 Co-30 Ni. Repeated treatments of heating at 500° C. for an hour and cooling in liquid N were given. Aside from determining the crystallographic relations it was established that one γ crystal can give rise to 4 differently oriented *h* crystals, which, by reverse transformation, are brought back to γ crystals of the original orientation. BWG (10)

4 **Transformation Gamma⟶Alpha of Stainless Invar Caused by Stress, and the Mechanism of the Transformation.** ZENJI NISHIYAMA. *Science Reports Tohoku Imperial University,* Vol. 25, Apr. 1936, pages 94-103. Transformation by stress was found by X-ray analysis to take place by the same mechanism as in the transformation by temperature change. Transformation started with a tensile stress of 20 kg./mm.^{2}, the yield point. Change took place first on the surface then proceeded inwardly. BWG (10)

Grain Size in Metals. M. G. OKNOV. *Metallurg,* Vol. 11, Mar. 1936, pages 3-8. In Russian. Grain size of Zn (0.03 Fe, 0.015 Cd, 0.009 Pb, Sb, Sn, Al none) was studied by adding to molten Zn small amounts of different elements. No conclusive results were reached, though several interesting theories are proposed. (10)

5 **Vanadium and Zirconium as Ternary Constituents in Al Bronzes (Il vanadio e lo zirconio come costituenti ternari nei bronzi d'alluminio)** C. PANSERI. *Alluminio,* Vol. 5, Mar.-Apr. 1936, pages 37-45. The effect of additions of V and Zr to 90-10 Al bronze has been studied. As little as 0.24% V has a refining action on the microstructure. The macrostructure, however, is coarsened. Zr also tends to give a finer microstructure, but its action is much less marked. AWC (10)

6 **X-Ray Investigation of the Iron-chromium-silicon Phase Diagram.** A. G. H. ANDERSEN & ERIC R. JETTE. *Transactions American Society for Metals* Vol. 24, June 1936, pages 375-419. Crystal studies by X-rays are reported for Fe-rich Fe-Cr-Si alloys. Interpolation and extrapolation based upon orthographic projection have been applied to determination of surfaces which represent variation of lattice parameter with composition in 1- and 2-phase regions. These parametric surfaces have been developed with considerable accuracy. α phase is homogeneous from 0-35% Cr at 600°, 800°, 1000° C. and is bounded by 3 surfaces. First is equilibrium with $(Fe, Cr)_3Si_2$, which is isomorphic with Fe_3Si_2; second and shortest is equilibrium with a phase isomorphic with Cr_3Si; third and largest is equilibrium with FeCr, which is found to exist over a wide range. This phase (σ) dissolves up to 9 or 10% of Si. σ forms by precipitation from binary and ternary α solid solution. α boundary in this region changes rapidly with temperature; thus precipitation hardening is possible over a wide range of composition. Diagrams cover the system below 50 at. % or 33% by wt. of Si. WLC (10)

7

8 **A Contribution to the Knowledge of Magnetic Anisotropy of Polycrystalline Materials (Ein Beitrag zur Kenntnis der magnetischen Anisotropie vielkristalliner Werkstoffe)** O. VON AUWERS. *Wissenschaftliche Veröffentlichungen aus den Siemens-Werken,* Vol. 15, May 1936, pages 112-123. Endeavors in recent years to produce materials with definite ferromagnetic properties and to influence the shape of the hysteresis loop are discussed, and the involved theory and the reason for magnetic anisotropy in the crystal axes of the material are explained. Means for producing magnetic irregularities by external forces, tension or compression, or internal forces by influencing the crystal lattice in polycrystalline commercial materials, are discussed on the basis of knowledge gained on monocrystals, and experiments are described which illustrate the practical application of theoretical principles to an Fe-Ni alloy. 37 references. Ha (10)

9 **Austenitic Grain Size: Estimation and Significance.** EDGAR C. BAIN. *Steel,* Vol. 98, May 11, 1936, page 66: Abstract of paper before interchapter meeting of American Society for Metals at Pennsylvania State College, May 1-2. Fine austenite grains, upon transforming, yield tougher heat treated structures than do coarser grains; tendency to crack is less; and critical quenching speed for hardening is higher for some composition having finer grains. Size of grains of austenite is determined from structure resulting from its decomposition. Polished and etched specimen will reveal grains by virtue of contrast in appearance between network and grain bodies. Suitably etched martensite faithfully reveals size of parent austenite grains from which it formed by difference in darkening of the several orientations. MS (10)

10 **Absorption of Soft X-rays in Aluminium.** G. B. BANDOPADHYAYA & A. T. MAITRA. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Vol. 21, May 1936, pages 869-880. The mass absorption coefficients were determined accurately for wave lengths from 7 to 25 A.U. The general absorption curves by Jönsson and Stobbe were found not to give accurate results due to the fact that in the soft X-ray region the part played by electrons close to the optical levels becomes appreciable and that therefore the simple laws holding good in the ordinary X-ray region for electrons in the deeper levels begin to become complicated. 20 references. Ha (10)

Factors Affecting the Structure and Properties of Gray Cast Iron. A. Di Giulio & A. E. White. *Transactions American Foundrymen's Association,* Vol. 7, June 1936, pages 531-565. The effect of superheating cast Fe of the unalloyed automotive-cylinder type (T. C. 3.36%; G. C. 2.76%; Si 2.00%; S 0.118%; P 0.36%; Mn 0.48%; O 0.012%; H 0.00015%; and N 0.0045%) was investigated by heating the metal to 3110° F. The beneficial effects of superheating were apparent at temperatures in the neighborhood of 2700° F. and increased with temperature up to a maximum at about 3040° F. The effect of pouring temperature on various cast irons was also investigated. An optimum range for pouring was established between 2680° and 2850° F. Better physical properties obtained through superheating and by pouring at the proper temperature are ascribed to a refinement of the graphite flakes. Specifically, the improvement in physical properties is due to the fact that, under proper conditions of melting and casting, the graphite flakes of the material of the charge are entirely dissolved. Evidence is furnished which proves that graphite will not all pass into solution at the eutectic temperature, but will persist as such in the melt, as revealed by quenching molten cast Fe in water. CMS (10)

Equilibrium in the Reaction of Hydrogen with Ferrous Oxide in Liquid Iron at 1600 Degrees Cent. M. G. Fontana & John Chipman. *Transactions American Society for Metals,* Vol. 24, June 1936, pages 313-336. Experimental study of the equilibrium of the reduction of dissolved FeO by H_2 at 1600° C. leads to the following conclusions. The equilibrium constant is independent of O_2 concentration. Activity of FeO in liquid Fe is proportional to its wt.%. Error in previous work is shown by correction of the constant from 4.75 to 3.95. Free energy of formation of FeO in 1% solution in liquid Fe determined as—34,740 cal. at 1600° C. (2910° F.). Value of C-Fe oxide product at equilibrium in liquid Fe calculated as 0.006 confirms experimental value of 0.010. Value of the constant of the water gas reaction found by using present data and that of Vacher agrees with other sources. 14 references. WLC (10)

Distribution of Hypereutectoid Cementite in Cemented Ni-Cr-Mo Steels (La distribuzione della cementite ipereutettoide negli acciai al Ni-Cr-Mo cementati) A. Bartocci. *La Metallurgia Italiana,* Vol. 28, Mar. 1936, pages 101-111. Presence of special elements causes displacement of the eutectoid point. The effect of cementation at 900°-1000° C. on a steel of the type 0.30% C, 3.5% Ni, 0.80% Cr, and 0.50% Mo has been studied. High temperature favors the formation of a continuous cementite network bordering the austenitic crystals, although part is trapped within. Rapid cooling after cementation increases the proportion trapped so that on very rapid cooling all the hypereutectoid cementite remains fixed within the crystals in the planes of cleavage. Subsequent heat treatment will eventually allow agglomeration of the hypereutectoid cementite more and more completely according to the number of cycles of heat treatment. AWC (10)

Casting Strains and Means of their Elimination (Ueber Gussspannungen und die Mittel zu ihrer Beseitigung) O. Bauer & K. Sipp. *Giesserei,* Vol. 23, May 22, 1936, pages 253-256. Annealing between 500° and 550° C. is sufficient to reduce harmful internal stresses. If annealed for not more than 2 hrs. the cementite does not disintegrate so that the mechanical properties are not deteriorated. Unnecessarily high annealing temperature (700° C. and more) should be avoided to prevent deterioration of mechanical properties because of disintegration of cementite at these temperatures. 6 references. Ha (10)

Decomposition of Solid Solution in Palladium-copper Alloys. P. S. Belonogov. *Metallurg,* Vol. 11, June 1936, pages 92-95. In Russian. Hardness, electric conductivity, microstructure and the thermal analysis study of the alloys indicated decomposition of solid solution with separation of a phase having a varying composition corresponding to Cu_3Pd and CuPd and present as isomorphous mixture. (10)

Some Studies in Microstructure of Zinc Coatings. W. E. Buck. *Journal American Zinc Institute,* Vol. 17, 1936, pages 70-75. A series of tests with hot dipped or galvanized sheets subjected to various types of service showed that the microscope, in many cases, is a valuable aid in confirming the information secured by other methods of analysis. A careful study of the mechanism and structures of coatings by means of the microscope will throw much light on unexpected coating failures and unsatisfactory sheet performance in service. RHS (10)

Magnesium Casting Alloys (Beitrag zur Kenntnis der Magnesiumgusslegierungen) H. Busch. *Giesserei,* Vol. 23, June 5, 1936, pages 291-295. A suitable method is described for making metallographic sections and the structure of the most used Mg alloys is explained. The possibility of changing the properties of Mg-Al and Mg-Zn alloys by heat treatment is discussed; Al-Mg alloys are only little improved by precipitation hardening, while the yield point of Mg-Zn alloys is increased by it about 75%, although the absolute value of the latter is lower than for Al-Mg alloys. The influence of heat treatment on the structure is demonstrated by photomicrographs. 12 references. Ha (10)

Chemistry of Intermetallic Compounds and Solid Solutions (Die Chemie der intermetallischen Verbindingen und Mischkristalle). U. Dehlinger. *Naturwissenschaften,* Vol. 24, June 19, 1936, pages 391-395. This short review touches on all important considerations necessary in the scientific study of the structure of alloys. It is pointed out that many of the classical laws and ways of interpretation of chemistry cannot be used in the present day study of alloy systems. While the data employed are purely chemical, new methods of using these data have been evolved from the use of electrochemical methods, X-ray and electron interference methods, refined magnetic and electric conductivity methods and the application of heat theory interpreted in the light of quantum mechanics. 9 references. HAS (10)

Atomic Weight of Cadmium (Ueber das Atomgewicht des Cadmiums) O. Hönigschmid & R. Schlee. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 227, May 12, 1936, pages 184-192. Description of procedure. Atomic weight of Cd determined to be 112.41. WB (10)

Recent Advances in Metallurgy. D. Hanson. *Aluminium & the Non-Ferrous Review,* Vol. 1, Apr. 1936, pages 292-295. Summary of lecture to the Midland Metallurgical Societies. JCC (10)

11. PROPERTIES OF METALS AND ALLOYS

Review of Research in Strength of Materials. F. L. Everett & J. L. Maulbetsch. *Journal of Applied Mechanics,* Vol. 3, June 1936, pages A67-A70. A list of 74 references pertaining to this subject. Ha (11)

Drill Stem. H. W. Fletcher. *American Petroleum Institute Drilling & Production Practice,* 1935, pages 150-157, discussion pages 157-161. Early rotary wells were drilled with low-carbon lapwelded drill stem; and difficulties arising from cross-threading, galling, rapid thread wear, and slow handling forced the development of the rotary tool joint. Increasing loads encountered, as well as depths increased, led to the introduction of medium-carbon seamless drill pipe with heavy upset and special thread form, together with heat-treated alloy joints. Recent changes in drilling practice adopted to decrease deviation of hole from vertical have emphasized certain factors which cause types of failure not previously general. The apparently simple drill-stem structure contains complicated design problems not susceptible of exact mathematical solution. The predominating type of failure is definitely fatigue, possibly accelerated by corrosion. Vibration, both torsional and transverse, is probably the principal destructive factor. Marked reduction of failures through metallurgical improvement is at present unlikely in the light of present knowledge. Some advantage may be secured through changes of design, although only by sacrifice in other directions, at the present less important. Much can be accomplished by greater care in the use of drill stem with special attention to those factors influenced by light weight and high rotative speed. VVK (11)

The Development of Rotary Drill Pipe. H. W. Graham. *American Petroleum Institute, Drilling & Production Practice,* 1935, pages 162-174, discussion pages 175-177. Follows briefly the long development of rotary drill pipe from its early form to a simplified mechanical design of advanced metallurgical quality. Specific points of importance were brought as follows: Early drill pipe was welded followed by seamless of higher strength. The ordinary pipe coupling was early replaced by the tool joint. The drill pipe was upset to compensate for reduction of all thickness in threading. The upsetting operation introduced metallurgical problems which require full-length normalizing for best results. A large proportion of failures occur in the threaded connection of drill pipe to tool joint. The last-engaged drill-pipe thread acts as a notch peculiarly susceptible to fatigue breaks under corrosive conditions. Drilling mud is a corrosive medium in promoting fatigue failures. There is no true fatigue-endurance limit under corrosive conditions. Twist-offs may occur by notch action under corrosion fatigue at very low stresses, particularly in older drill pipe. Drill pipe should not be cold-stamped. Welding the threaded connection of drill pipe and tool joint is an expedient, and not the best remedy for breaks or wash-outs. The use of welding to eliminate the threaded connection of drill pipe to tool joint involves difficulties that are unfavorable to the consideration of this method. The threaded connection of drill pipe to tool joint can be eliminated by forging an upset on the drill pipe of proper shape to act as a tool joint. Proper heat treatment of a forged integral joint of a special Mn steel produces a coupling adequate to tool-joint requirements. 5 references. VVK (11)

Slow-Bend and Impact Tests of Notched Bars at Low Temperatures. H. F. Moore, H. B. Wishart & S. W. Lyon. *Preprint American Society for Testing Materials,* June 1936, 6 pages. Results are given of slow-bend and impact tests of the following metals at temperatures ranging from ordinary room temperature to 40° below zero F.; S.A.E. Nos. 3135, 1020 and 1095, 60-40 brass, Cu and duralumin. The correlation between results from slow-bend tests and from impact tests over this temperature range is not greatly different from that found by Petrenko for ordinary room temperatures. The autographic slow-bend testing machine used is described. In a flexure test of a notched-bar specimen the friction of striking edge along the specimen seems to be a rather serious source of error, especially for specimens of metal so ductile that after the test they are not broken clean in two. Tension tests of notched specimens, both impact tests and slow-pull tests, are suggested as worthy of experimental study. VVK (11)

■ 11a. Non-Ferrous ■

A. J. PHILLIPS, SECTION EDITOR

Present Status of Fabrication, Working and Use of Aluminum-Bronze (Gegenwärtiger Stand der Herstellung, Verarbeitung und Verwendung von Aluminiumbronze) E. Lay. *Werkstatt und Betrieb,* Vol. 69, June 1936, page 154. The alloys for technical use are of Cu plus 4-10% or more Al. The binary alloys with more than 11% Al are brittle; additions of Fe, Mn, Ni, Si or Zn permit increasing the Al to 11-12% without danger of brittleness. All Al bronzes are resistant to oxidation, especially at elevated temperatures, chemicals and seawater. The properties of the alloys are improved by heat treatment. Rolled and drawn wire of an alloy of 5% Al showed a tensile strength of 101.4 kg./mm.² and an elongation of 3.6%. HR (11a)

Nickel Brass (Neusilber) Rudolf Krulla. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* No. 17, 1935, 64 pages. A brief monograph on Ni brass. Part I, dealing with properties, treats of color, melting point, hardness, strength and elongation, thermal e.m.f., electric resistance, thermal conductivity, and electrolytic potential. Part II, dealing with the influence of added elements, treats of the influence of Mn, Fe, Pb, Sn, Al, O, S, C, Si, P, Mg, Ag, As, Sb, alkali metals, and gases. Part III deals with melting, casting, working and annealing. Part IV deals with different possible defects. Part V contains information on corrosion resistance. Part VI is a discussion of physiological effects. Part VII is a discussion of applications. Part VIII is a bibliography of 9 references. JLG (11a)

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Relation of Temperature to Crystal Plasticity (Zur Temperaturabhängigkeit der Kristallplastizität) W. Boas & E. Schmid. *Zeitschrift für Physik,* Vol. 100, May 16, 1936, pages 463-470. Contrary to the Becker-Orowan theory, the authors found no relation between heating effects and crystal plasticity for crystals of Zn, Cd, Bi and Sn when subjected to plastic elongation under constant load both at room temperature and at 90° abs. FHC (11a)

Mechanical Properties of Pb-alloys. Kyukiti Simba. *Sumitomo-densen-iho,* July, 1936, pages 1-33. The elastic limit of Pb is 17 kg./cm.², while those of the alloys containing 3% Sn and 1% Sb are 39 kg./cm.² and 43 kg./cm.² respectively. From the results of alternate bending fatigue testing, Sn does not affect the endurance limit of Pb, but Pb alloys with 1% Sn and 0.05% Ca showed a marked increase of endurance. Rotating cantilever fatigue testing gave similar results; the fatigue limit of Pb was 17 kg./cm.² and that of Pb with 3% Sn was 27 kg./cm.², while those of Pb alloys with 1% Sb and 0.05% Ca were respectively 81 kg./cm.² and 125 kg./cm.² Under permanent static load Pb broke at 50 kg./cm.² The age-hardened Ca-Pb and Sb-Pb crept less than Pb and annealed alloys under small load. Sn-Pb alloy, however, showed more creep than Pb under a load less than 18 kg./cm.² Temperature had considerable effect upon the creep. The hardness of 1% Sb-Pb alloy at 150° C. was the highest among these alloys, but above that temperature was less than that of 3% Sn-Pb alloy. The tests are summarized as follows:

		Tensile Strength kg./cm.²	% Elong. in 4√A	Brinell Hardness	Yield Point	Elastic Limit	Endurance Limit
Pb	extruded	143	76	4-4.5	31	17	17
3% Sn-Pb	extruded	209	70	7-7.5	75	39(25)	27
1% Sb-Pb	extruded & aged	250	36	8.5-9.0	101	43	81
1% Sb-Pb	extruded & annealed	200	—	6.5-7.0	—	—	—
0.05% Ca-Pb	extruded & aged	300	45	9.0-9.5	—	—	—
0.05% Ca-Pb	extruded & annealed	220	60	7.0-7.5	—	—	—

HN (11a)

Beryllium-Copper-Cobalt Alloys. F. G. Benford. *Metal Industry,* New York, Vol. 34, June 1936, page 226. Addition of Co to Be-Cu alloys lowers the amount of Be necessary for heat-treating to optimum physical properties. The principle use of this material has been in resistance welding equipment where good conductivity, hardness, and the ability to withstand severe heat are important factors. This alloy has been used as electrode material for all types of stainless steel resistance welding; spot, seam, flash, and projection; and in flash and projection welding of C steel. Another application is for electric soldering iron tips. CBJ (11a)

Nickel in Brass Foundry Practice. D. M. Curry. *Metal Industry,* New York, Vol. 34, Sept. 1936, pages 330-332. Properties of Ni bronzes are discussed. Ni in Ni-silvers imparts a silvery white color and increaeses the resistance to tarnish and corrosion. Effects of impurities on Ni silvers are noted. Foundry practice for Ni silver alloys and molding sands are discussed. CBJ (11a)

Aluminum Bronzes and Their Heat Treatment. M. G. Corson. *Metal Industry,* New York, Vol. 34, July 1936, pages 250-253. Physical properties, structure and applications of Al bronzes are discussed. Effects of alloying and heat treatments are considered. 3 standard alloys are: (1) 9% Al, 3.5% Fe, with or without 1% Mn and 1% Ni. (2) 10.3-10.5% Al, 4.5% Fe, 0.3% Sn with or without Mn and Ni. (3) 11% Al, 5% Fe, 1% Mn, 1% Ni. CBJ (11a)

Anomaly in Annealed Copper (Sur une anomalie du cuivre recuit) M. Cirou. *Revue de Métallurgie,* Vol. 33, July 1936, pages 413-419. Points to a close relation between the origin of Cu, its remelting practice and the temperature which gives the best ductility after annealing. JDG (11a)

Permalloys and Related Ferro-magnetic Alloys. J. G. Chaston. *Metal Treatment,* Vol. 2, Summer 1936, pages 58-66, 71; *Electrical Communication,* Vol. 15, July 1936, pages 38-51. A correlated abstract. The magnetic characteristics of high permeability alloys are outlined, and an account given of the developments which have followed Elmen's discovery of the 78.5:21.5 Ni-Fe alloy, permalloy. Higher permeabilities, secured with a simple anneal, have been found in certain of the Ni-Fe-Cu, Ni-Fe-Mo, and Ni-Fe-Cr alloys, while constant-permeability alloys have geen found in the Ni-Fe-Co series. The effects of crystal size and orientation, of the application of magnetic fields during heat treatment, and of cold work are reviewed, magnetic theories developed to account for the results outlined, and the influences of impurities discussed. 36 references. JCC (11a)

What is Phosphor Bronze? M. G. Corson. *Metal Industry,* New York, Vol. 33, Dec. 1935, pages 428-429. 2 types of phosphor bronze are used: (1) 4-6% Sn and minute amounts of P used for strips and wires but never cast. (2) 10-13% Sn and 0.05 to 0.5% P used for cast gears. P increases the fluidity of the liquid metal but not necessarily the "castability" since the amount of heat and heat conductivity are the important factors. Phosphor bronze must be made under the best controlled melting practice to prevent the molten metal from absorbing gas before the phosphor Cu is added. Since gear blanks are not cast to size but are machined the fluidity is of no importance. Since by the addition of P hardness is not enhanced, ductility is decreased, and ultimate strength is unaffected, the author finds no reason for the claimed superiority due to the use of the element. CBJ 11a)

A "Free Machining" Monel Metal. O. B. J. Fraser. *Iron Age,* Vol. 138, Aug. 13, 1936, page 37. Describes a new type of monel metal developed at the Huntington works of International Nickel Co. It is known as "R" monel metal. This machinable metal is produced by small addition of S. It is slightly less corrosion resistant than ordinary forms of monel metal. It is produced in different grades. Includes table giving comparison of relative mechanical strengths. VSP (11a)

Crystallization of Metals Without the Influence of Gravitation (La cristallisation des métaux sans influence de la gravitation) A. Glazunov & N. Lazarev. *Revue de Métallurgie,* Vol. 33, July 1936, pages 438-441. Mg was allowed to solidify slowly in a molten mixture of 85% LiCl + 15% LiF. As at 650° C. specific gravity of the mixture is 1.60, the same as Mg, the metal remained suspended in it in the shape of globules. This freed it from the influence of containing walls. Crystalline structure produced was exactly the same on the outside and in the center. The metal was perfectly solid. The same experiments were conducted with Al using a mixture of 40% $BaCl_2$, 45 $CaCl_2$ and 15 NaCl. JDG (11a)

Aluminum Alloy with Mg-Zn_2 Content as Casting Alloy (Die Aluminium-Legierung mit $MgZn_2$-Gehalt als Gusslegierung) H. Schmitt & P. Bergmann. *Aluminium,* Vol. 18, Aug. 1936, pages 370-373. The (German) Al casting alloy G54 contains Mg and Zn in such proportions that the compound $MgZn_2$ is formed. This alloy is suitable for sand and chill mold casting; it is particularly suitable for fixtures and fittings, in domestic appliances, shipbuilding and automobile manufacture. It is very corrosion resistant and, when coated by the eloxal process takes a silver-white or slightly yellowish tint. Methods of casting, hardening and surface treatment are briefly described. Ha (11a)

On the Growth of Gray Cast Iron. Hiroshi Sawamura & Jiro Yamamoto. *Suiyokwai-Shi,* Vol. 9, July 1936, pages 31-38. The author investigated the influence of various gases, such as ammonia, methane, water vapor, and mixed gas consisting of CO and H, on the growth of gray cast Fe, and also the influence of various atmospheric conditions on the graphitization of pearlite cementite in order to test the hypothesis of Benedicks and Löfquist that the irreversible abnormal expansion during repeated heating and cooling through A_1 transformation point is due to the graphitization of pearlite cementite produced during Ar_1 transformation. The results of the experiments confirmed the hypothesis of Benedicks and Löfquist. HN (11a)

Aluminium-magnesium Alloys. Pierre Vachet. *Aluminium & the Non-ferrous Review,* Vol. 1, Apr. 1936, pages 301-309. Translated from *Revue de Metallurgie.* See *Metals & Alloys,* Vol. 7, Aug. 1936, page MA 417L/6. JCC (11a)

Palladium and Palladium Leaf. Alan B. Thomas. *Metal Industry,* New York, Vol. 33, Oct. 1935, page 354. Pd, a member of the Pt group, is white in color, non-fading and non-tarnishable, is workable and easily alloyed. It has a high m.p. 1554° C.; its density is 12.16 or about 20% lighter than 18 karat Au. Pd is found in the Cu-Ni ores of Sudbury, Ontario. Pd is used in the decorative arts, in dentistry, jewelry, and electrical contacts. Pd leaf is 99.8% pure Pd and is produced similarly to Au leaf. CBJ (11a)

Age Hardening of Cast Aluminum Alloys Containing 9% $MgZn_2$ and their Mechanical and Corrosion-resisting Properties (Über die Veredlungsfähigkeit der Gusslegierung Aluminium + 9% $MgZn_2$ nach ihren mechanischen und Korrosions-Eigenschaften) Heinz Günther Wiechell. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* No. 13, 1934, 52 pages. The theory of precipitation hardening is discussed. Cast and rolled Al alloys containing 9% $MgZn_2$ were heat treated to bring about precipitation hardening and their properties determined. The cast alloys responded to heat treatment just as did the wrought alloys. Degassing the alloys to be cast increased their apparent density. Hardness at elevated temperatures was determined and found to be high for Al alloys. The alloys were as resistant to sea water as the Al alloy "KS-Seewasser." The addition of 0.48% Ti had no effect on the properties of the alloys. 55 references. JLG (11a)

Free Cutting Aluminum for Screw Machine Work. L. W. Kempf & W. A. Dean. *Metal Industry*, New York, Vol. 33, Aug. 1935, pages 277-279. See *Metals & Alloys*, Vol. 7, Jan. 1936, page MA 30L/1. CBJ (11a)

Castings in Silumin Gamma. G. Sachs & E. Scheuer. *Metal Treatment*, Vol. 2, Summer 1936, pages 94-98. Slightly abridged translation from *Metallwirtschaft*. See "Properties of Silumin Containing Magnesium," *Metals & Alloys*, Vol. 7, May 1936, page MA 258R/5. JCC (11a)

Ductility Testing of Aluminum and Aluminum Alloy Sheet. R. L. Templin. *Preprint American Society for Testing Materials*, June 1936, 10 pages; *Sheet Metal Industries*, Vol. 10, Aug. 1936, pages 595-597. Because of the great diversity of opinions as to what constitutes ductility of a metal and as to just what measures this same quantity, a number of existing tests purported to give a measure of this property are reviewed. The results of bending tests are discussed from the point of view of comparisons with tension test data with evidence to show that there seems to be no reliable correlation between them. Some results of Erichsen tests are similarly discussed and data presentd to show that, here again, there is no reliable correlation between the Erichsen values and tension test values or bending test values. Difficulties involved in the Sachs ductility tests in arriving at indices of ductility are pointed out. Data from about 1500 observations of these various tests are discussed from the viewpoint that each type of test might offer some particular information regarding a particular type of forming but that no one or any combination of them appears to yield a general quality factor indicating by a single number the quality of the metal in the light of all of the varied definitions of ductility. Data for the simple 180° and repeated 90° cold-bend tests, the Erichsen test, the Sachs ductility test and the tension test are given for the following alloys: commercially pure Al in 3 tempers; soft, half-hard and full-hard; the Al alloys 3S, 4S, 52S, 51S and 17S. VVK + AWM (11a)

Effect of Iron Impurities on the Annealing of High Brass. W. A. Gibson & J. H. Doss. *Preprint American Society for Testing Materials*, June 1936, 6 pages. The paper gives the effect of Fe impurities on the annealing of high brass for temperatures from 600° to 1200° F. and for Fe impurities from 0.008 to 0.287%. In high brass having Pb and Fe as the only impurities, Fe contents as high as 0.09% are not harmful to annealing. In such material a great discontinuity in annealing properties occurs between 0.09% and 0.118% Fe. Fe greater than 0.118% is not harmful to sheet high brass provided proper allowance is made in processing and use for its annealing properties. If these allowances are not made it is very harmful. The explanation offered for the sudden discontinuity in the effect of Fe is the formation of a Cu-Fe-Zn compound at the grain boundaries during the initial recrystallization, this enveloping boundary preventing further amalgamation of grains until it reaches a high temperature at which it is taken into solution and annealing again occurs. VVK (11a)

Temperature Coefficient of Electric Resistance of Aluminum (Coefficient de témperature de la résistance électrique de l'aluminium) Maurice Henri. *Revue de Métallurgie*, Vol. 33, July 1936, pages 420-421. Temperature coefficient of electrical resistance was determined in the interval 20°-78° C. on cold drawn bars 8 mm. in diameter annealed at 320° C. for 3 hours and cooled in the furnace. The results obtained and reduced to 20° C. were: for 99.9% Al temperature coefficient was 0.00433 ± 0.00008, for 99.56% Al it was 0.00400 ± 0.00008, for 99.1 Al it was 0.00413 ± 0.00008, for 98.5 the figure obtained was 0.00400 ± 0.00008. JDG (11a)

Heavy Pressure Bearing Alloy Developed. *Steel*, Vol. 98, Mar. 30, 1936, pages 48, 50. Note on Nicuite, a bearing metal capable of carrying heavy loads at slow to medium speeds, developed by A. W. Cadman Mfg. Co., Pittsburgh, Pa. It has a yield-point in compression of 24,000-25,000 lbs./in.^{2}, tensile strength of 55,000 lbs./in.^{2}, yield-point of 48,000 lbs./in.^{2}, elongation in 2″ of 6-8%, and Brinell hardness of 100-120. MS (11a)

The Influence of Sodium and Calcium on Aluminum. B. F. Grashchenko & V. Darovskii. *Legkie Metallui*, Vol. 5, Jan. 1936, pages 17-37. In Russian. The presence of Ca up to 0.1% and of Na up to 0.04% does not affect the physical and mechanical properties of Al to any appreciable extent. Above these limits, Ca and Na decrease electrical conductivity and increase intercrystalline corrosion. Si decreases the influence of Ca by forming $CaSi_2$. HWR (11a)

Optical Constants of Copper-nickel Alloys. N. F. Mott. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 22, Aug. 1936, pages 287-290. The relation between optical constants and magnetic properties of Cu-Ni alloys is theoretically interpreted. Ha (11a)

■ 11b. Ferrous ■

V. V. KENDALL, SECTION EDITOR

More Developments in Stainless Steel. H. Etchells. *Metal Treatment*, Vol. 2, Summer 1936, pages 85, 88. A letter advocating the use of a high Ni content (about 30%) to insure stability of structure and freedom from weld decay in austenitic stainless steels. JCC (11b)

Influence of Molybdenum and Titanium on Low Carbon Chromium Stainless Steel. N. T. Gudtzov & L. N. Balakina. *Kachestvennaia Stal*, Vol. 4, No. 6, 1936, pages 52-53. In Russian. Influence of Mo and Ti addition to 0.1-0.2% C, 15-16% Cr steel was investigated. 3 and 4% Mo increase the depth of dendritic zone in ingots, 0.5% Ti entirely suppresses it, increasing grain growth. Mo reduces intensity of allotropic transformations, Ti renders steel ferritic. Heat resistance of the steel is decreased by Ti and increased by Mo. No pronounced improvement in corrosion resisting properties was observed. (11b)

Substitute Steels. K. P. Grigorovich. *Kachestvennaia Stal*, Vol. 4, No. 3, 1936, pages 7-12. In Russian. A review of gradual replacement of high alloy steels with those containing less alloying elements. (11b)

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Strength and Elastic Properties of Cast Iron. W. J. Schlick & B. A. Moore. *Iowa Engineering Experiment Station Bulletin No. 127*, 1936, 95 pages. This important piece of work is an outgrowth of the investigations carried on at this station for the A. S. A. Committee A-21 (on cast Fe pipe). It is the first study which has come to the reviewer's attention of the performance of cast Fe under combined tension and transverse stress, which is the usual condition of stress in underground cast Fe pipes lines. The authors use four cast irons of quite different properties, ranging from 36,000 to 67,000 lbs. modulus of rupture on the standard pipe bar (2″ x 1″ x 24″). Each Fe was cast in 3 different thicknesses, .5″, .9″, and 1.25″ and tests run in transverse, tension, and breaking loads in transverse stress with 20, 40, 60, and 80% improved tensile stress. All other properties of the usual nature are recorded, and the results shown to follow the equation:

$$R - R_1 = R\left(\frac{S_1}{S}\right)^{1.70}$$

in which R = ultimate flexural stress $\frac{Mc}{I}$ with no tension, S = ultimate tensile stress with no flexure,
R and S = flexural and tensile stresses when they act simultaneously. The corresponding relationship derived from the results of cast Fe pipe is

$$S - S_1 = S\left(\frac{}{R}\right)^2$$

The data from which the latter equation is derived are not yet released, but will be in a future publication of the experiment station. The 2 curves are quite similar. This bulletin represents a very careful piece of work and the conclusion will have an important bearing on the design of cast Fe pipe as well as other parts subject to such combined stresses. The present knowledge of the behavior of cast Fe in bending is critically considered in the light of the present tests. This section is unusually complete and is accompanied by an excellent bibliography. JTM (11b)

Some High-Temperature Properties of Niobium. A. L. Reimann & C. Kerr Grant. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 22, July 1936, pages 34-48. Specific resistance, total thermal radiation, and rate of evaporation of extremely pure Cb (less than 0.02% Sn as only impurity) was determined in the range of 1800°-2400° K. The lattice constant was found to be 3.2935 ± 0.0005 A. U., atomic weight 92.91 and density 8.58. The m.p. is 2770° K. Ha (11b)

Specific Heat of Nickel. E. C. Stoner. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science*, Vol. 22, July 1936, pages 81-106. A detailed analysis of the specific heat of Ni was made which was found to be composed of 4 terms, c_p and c_v, as usual, and an electronic term c_e and a magnetic term c_m. The tests over a range of 1000° C. are described in detail. 21 references. Ha (11b)

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Influence of Simultaneous Presence of Chromium and Manganese in Structural and Stainless Steels. A. B. KINZEL. *Kachestvennaia Stal,* Vol. 4, No. 5, 1936, pages 7-12. In Russian. Structural alloy steels can be subdivided into 3 groups, steels producing the desired physical properties without any heat treatment and used for large constructions, usual structural alloy steels the desired properties of which are developed by appropriate heat treatments and steels having a high content of alloying elements conveying to them stainless characteristics. Every element exerts a specific influence on the properties of the metal containing it. When the possibility of a suitable heat treatment is eliminated, the desired properties of steel can be obtained by balancing influences of different alloying constituents and their amounts. Many steels of this type are already on the market containing comparatively small percentages of cheap elements such as Cr, Si, Mn and Cu. In the stainless steel field considerable cheapening of the alloys can be obtained by replacing all or most of Ni present with Mn. Good results were obtained with a steel containing 18% Cr, 8 Mn, 1 Cu and 0.1 C. Quenched from 1050° C. it is composed of 60% austenite and 40% Cr-bearing ferrite. This 2-phase steel can be more easily rolled and drawn than straight austenitic steels. It has good physical properties, good machining characteristics, is cleaner than the usual 18-8, and can be welded more easily. It has some intergranular corrosion properties and cannot be stabilized by addition of carbide forming elements. In moist hot atmosphere it has better corrosion resistance than any stainless steel with the exception of 18% Cr, 6 Mn, 4 Ni and 1 Cu steel. See also *Metals & Alloys,* Vol. 7, Oct. 1936, page MA 507L/8. (11b)

Molybdenum-Tungsten High-Speed Steels. J. V. EMMONS. *Canadian Chemistry & Metallurgy,* Vol. 20, May 1936, pages 158, 160. An abstract. Various Mo steels and commercial Mo-W steels are briefly discussed, as well as tool steel inspection and heat treatment of high-speed steel. WHB (11b)

Nickel-Aluminum Compound, A Hardener for Steel. FRANCIS B. FOLEY. *Metal Progress,* Vol. 29, May 1936, pages 53-56. A Ni-Al-Fe alloy (C 0.03, Mn 0.16, Si trace, Ni 5.03, Al 2.59), produced in 4" square ingots was hammered to ½" square bars at 2050°-2075° F. with a Brinell hardness of 309 in the as forged condition. Quenching experiments were started at 1100° F., and then in steps of 100° up to 2100° F., duplicate specimens being heated for 15 min. to each temperature. There was practically complete absorption of the hardening compound at 1500° and higher, which was retained by water quenching but not by air cooling. By drawing at 1050° F. the hardness was increased for water quenching from 210 to 360 and for air quenching from 280 to 350. A 1300° F. quench after holding 12 hrs. followed by drawing 12 hrs. at 1050° F. produced the maximum hardness. The fact that 1050° F. draw produces the maximum hardness suggests possible combination of this hardener in high speed steel or nitriding steels where treatments are at similar temperatures. WLC (11b)

Magnetic Alloys of Iron, Nickel and Cobalt. G. W. ELMEN. *Bell System Technical Journal,* Vol. 15, Jan. 1936, pages 113-135. See *Metals & Alloys,* Vol. 7, Mar. 1936, page MA 146R/5. HFK (11b)

Working of Copper Steels (Le Travail des aciers au cuivre) E. HERZOG. *Métaux,* Vol. 10, Dec. 1935, pages 347-353. Cu steels are classed in 3 groups: (a) 0.3-0.5% Cu low C steel; (b) 0.5% Cu, 0.5% Cr, and medium C steels; (c) low C steels with 0.8-1.2% Cu. According to Hanson the solubility of Cu in Fe is 5% at 800° C., 0.4% at 600° C., and 0.2% at 20° C. Addition of 1% Cu will produce same hardness in steel as the addition of 0.12% C. Steels with 0.5% Cu can be cold worked as well as soft plain C steels. With Cu content higher than 0.50% there seems to develop some difficulty in hot rolling at temperatures higher than 1000° C. Cu steel should be rolled at 1100° to 1200° C. Steels with 0.5% Cu offer no difficulty on welding. GTM (11b)

Stainless Steels. W. H. HATFIELD. *Journal Institution of Production Engineers,* Vol. 15, Feb. 1936, pages 47-83. A general account of the discovery of stainless steels, their applications and properties. Tables showing the loss of weight of Ni, Cr, and Ni-Cr steels in HCl, H_2SO_4, and HNO_3 show that Cr additions afford protection from HNO_3 through the formation of a passive film and Ni gives increased resistance against HCl and H_2SO_4. In an appendix, notes are given on hot and cold working, welding, soldering, and machining of stainless steels. JCC (11b)

The Properties of Genuine Cold-Blast Pig-Irons. J. E. HURST. *Foundry Trade Journal,* Vol. 54, Jan. 30, 1936, pages 99-100. Orthodox metallurgical opinion today recognizes the fact that the properties and qualities of materials vary independently of their chemical composition. In the case of pig-irons, the most outstanding examples of the difference in properties and behavior for irons of similar chemical composition are to be found in the comparison of the properties of genuine cold-blast pig irons with pig-irons made by other methods. These differences are often referred to as inherent or intrinsic properties. These differences in properties are not confined to the mechanical strength. Genuine cold blast irons are tougher than other irons. Tensile strength is no criterion of toughness. The modulus of elasticity expresses a measure of the stiffness and the amount of permanent set, and the shape of the stress-strain curve gives valuable and quantitative data relating to the elastic properties. The area of the stress-strain curve or the value of the energy absorbed in breaking test specimens either in tensile or transverse loading is a much closer quantitative measure than the ultimate breaking strength. It is shown by the author that the modulus of elasticity of the foundry Fe is greater than the cold-blast specimen. In spite of the lower strength value, the resilience value in the sample of cold-blast Fe is greater than the foundry Fe. AIK (11b)

Mechanical Properties and Carburization Characteristics of Some Si, Mn, Cr and Cu Alloy Steels. S. S. KANFOR. *Metallurg,* Vol. 11, Apr. 1936, pages 75-89. In Russian. 13 steels containing about 1% of these elements either separately or in combination were studied. Physical properties were obtained after quenching in oil or water and after carburization and quenching. The steel which had the best physicals after heat treatment contained: 0.23 C, 1.14 Si, 1.50 Mn, 1.25 Cr. Its properties were close to the best Ni-Cr steels. After carburization the order of quality was entirely changed, and a steel with 0.20 C and 2.59 Cr was the best. Detailed description of the properties of all steels investigated is given. (11b)

Changes in Austenitic Steels on Tempering and Annealing. ANDRE MICHEL. *Metal Progress,* Vol. 29, June 1936, pages 72-74. In tempering hypereutectoid austenite 3 reactions intermingle:

1. Supersaturated γ solution → carbide γ solution with less carbide
2. γ solution → carbide and martensite
3. γ solution → martensite.

Reactions 1 and 2 take place during actual tempering and 3 takes place during the cooling. 5 references. WLC (11b)

Modern Trends in the Quality and Use of Cast Iron. R. S. MACPHERRAN. *Mining & Metallurgy,* Vol. 17, Apr. 1936, pages 182-186. Trends in manufacture and use of cast Fe are decidedly toward specialization, alloy Fe and increased strength. Discusses high test cast Fe and results obtained by Allis-Chalmers Mfg. Co. on tests of separately cast bars and bars from large castings. Considers the various present day alloy cast Fe and heat treatment. VSP (11b)

18-8 Is the Favored Stainless Alloy in Germany. BENNO STRAUSS & EDUARD HOUDREMONT. *Metal Progress,* Vol. 29, June 1936, pages 70-72. The application of stainless steels in Germany began with chemical industries and has spread to food equipment, architectural and automotive applications. 1-5% Mo addition is used for increased fatigue strength and resistance to hypochlorite. N_2 additions are found to refine the grain. Economic reasons affect the amounts of Ni, Cr and Mo used in German steels as they must be imported. Bimetals are widely used. Mn is substituted for Ni for economy. WLC (11b)

Abrasion Resistance of a Low Alloy Steel, Medium Manganese. F. A. WICKERHAM. *Metal Progress,* Vol. 30, July 1936, pages 64-66. Describes a new steel for abrasive applications which has tensile strength of 100,000-125,000 lbs./in.^{2} in as rolled condition and may be heat treated to 150,000 lbs./in.^{2} Usual fabrication methods apply. Composition is C 0.35-0.50, Mn 1.50-2.00, max. P 0.050 and S 0.055, Si 0.15-0.30. WLC (11b)

The Relative Values of White and Black Heart Malleable Castings to Production and Service. WALTER WEST. *Journal Institution of Production Engineers,* Vol. 15, Apr. 1936, pages 174-184. Includes discussion. Outlines the general characteristics of "black-heart" (containing 2.4% C, malleablized without loss of C to a structure of graphite and ferrite) and "white-heart" (made from 2.7% C iron annealed in Fe ore) malleable cast Fe. "Black-heart" castings machine easily and their use is extending. JCC (11b)

Electric Cast Irons (Les fontes électriques) *Journal du Four Electrique,* Vol. 45, May 1936, page 166. Besides the usual types of electric cast Fe some of the commercially produced irons contain Cr and Ti for use as ingot molds and Cr for heat resisting uses. JDG (11b)

Izod Toughness vs. Tensile Strength of Heat Treated S.A.E. Steels. *Metal Progress,* Vol. 29, May 1936, page 57. Graphs show this relation for most automotive steels. WLC (11b)

Cast Iron with High Mechanical Strength (Fontes à haute Résistances Méchaniques) Dudouet. *Usine,* Vol. 45, Mar. 26, 1936, page 27. The historical development of the improvement of cast Fe by producing a uniformly distributed pearlitic structure, advantages of such Fe, and means for obtaining it are reviewed. The best method is to melt cast Fe turnings (of about 60 mm. thickness) in the cupola, and add, at the moment of pouring, 0.5% Si, and, if S must be eliminated, Na_2CO_3. Pigs of 60 cm. thickness should be cast in order to have a small surface exposed to air, and they should cool slowly. Si-cast irons with less than 1.9% C have been obtained in this manner with a Brinell hardness of 201 and a deflection of 23 mm. under 650 kg. load. This cast Fe contains P which is an advantage. Ha (11b)

Manufacture and Characteristics of Carbon Steel. H. W. Graham & J. H. Flaherty. *American Petroleum Institute, Drilling and Production Practice,* 1935, pages 190-208. A comprehensive review of the subject covering blast-furnace pig iron, bessemer process, open hearth process, electric furnace steel, deoxidation methods, effects of constituents on properties, effects of working on properties, metallography of plain C steel and air-hardening Mn steels. 14 references. VVK (11b)

Production of Refractory Cast Iron (Fabrication des Fontes réfractaires) Guy Henon. *Revue de Fonderie Moderne,* Vol. 30, Apr. 25, 1936, pages 129-138. Modern types of heat resistant cast Fe are reviewed and the various chemical compositions described. Ha (11b)

Making Low Chromium Manganese Steel for a 75 Ton Railroad Crane. A. N. Jhironkin. *Kachestvennaia Stal,* Vol. 4, No. 6, 1936, pages 40-46. In Russian. Detailed description of making and properties of steel containing 0.15-0.22% C, 0.17-0.37 Si, 0.9-1.2 Mn, 0.4-0.7 Cr. No particular difficulties are involved in open hearth practice though care must be exercised. The steel has good physical properties in as rolled condition, though it is quite sensitive towards changes in rolling practice. (11b)

The Fe-Cr Alloy System. The Brittle, Non-Magnetic Phase. Eric R. Jette & Frank Foote. *Metals & Alloys,* Vol. 7, Aug. 1936, pages 207-210. A complicated structure, Σ phase, has been found to exist in binary alloys of high purity in neighborhood of the composition FeCr. Transformation of this phase is discussed as to rate in light of 3 factors of possible influence: (1) possible stabilization effect of Si on Σ phase, (2) an accelerating effect by Si, and (3) an accelerating effect of cold work. Experimental evidence tends to indicate (2) and (3) are more important factors. Transformation temperature of an alloy 50.6 at. % Fe is between 775° and 800° C. and is strictly reversible. WLC (11b)

Influence of Chemical Composition and Casting Temperature on Casting Properties of Iron. P. G. Petrov. *Liteinoe Delo,* Vol. 7, No. 6, 1936, pages 4-15. In Russian. Casting properties of gray and malleable irons were determined by casting spirals of standard design under production conditions. Metal was taken into 50 kg. ladles from cupolas. Desired additions were preheated and added to this ladle. Temperature was determined with an optical pyrometer. Fluidity in casting for both irons is a practically direct function of temperature. Si increases casting properties up to 3.5-3.8% Si in both irons when they contain 3.3-3.4% C. With higher Si content they decrease. This is connected with changes in the interval of primary crystallization. P was investigated only in the range 0.2-0.6%. It greatly increased fluidity. Mn, Cr (0.3-1.2%) and Ni up to 1% do not have any influence. (11b)

The Effect of Phosphorus on the Properties of Basic, Unalloyed Steel (Ueber die Wirkung des Phosphors auf die Eigenschaften von basischem, unlegiertem Stahl) A. Ristow. *Mitteilungen der Kohle und Eisenforschung G.m.b.H.,* Vol. 1, Nov. 1935, pages 49-84. The relation between P content and mechanically important properties of plain steel were investigated by statistical methods from results of a great many tests in different plants. As one of the principal conclusions it was found that the usually accepted harmful effect of P does not exist in fact; that, on the contrary, P in unalloyed C steel, whether produced in the open-hearth or in the Thomas process, is even desirable in amounts of about 0.08%, as this is a sure preventive to "sticking," especially in rolling of very thin sheets; a further increase would still be better but makes the sheets too stiff so that they will not be as good for deep-drawing. A very low P content, of 0.04-0.045%, makes the rolling of such sheets even almost impossible, and has other harmful effects inasmuch as the formation of non-metallic inclusions in heavy forgings is favored, wear increased and corrosion resistance lowered, and also forgeability and machinability are deteriorated. Care should, however, be taken to avoid too large segregations during the deoxidation period and casting. The P content shows a very close relation to O and Mn content, the O content is usually lower with higher P content. Literature is reviewed which also confirms that in the last 10 years, the P content in mild steel has in general gradually become higher. 86 references. Ha (11b)

Drillability of Cast Iron (Bohrzerspanbarkeit von Gusseisen) Herman Schropp. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* No. 14, 1934, 102 pages. 7 different cast irons were studied. Bending, tensile, hardness, and wear-resisting properties were determined by different methods and an attempt made to correlate the different properties. The machinability as determined by drilling was compared with other properties. JLG (11b)

Substitute for a High Speed Steel. *Kachestvennaia Stal,* Vol. 4, No. 6, 1936, page 54. In Russian. 4 heats were made containing 1% C, 0.3 Si, 0.3 Mn, 4% W and 12% Cr. Forged at 850°-1080° C. and quenched in oil at 1075°-1100° C. the steel had 60 Rockwell. Drawn at 450° C. it had a hardness of 56-57 Rockwell. First results when used as milling cutters were satisfactory, but further experiments are needed to establish its quality. (11b)

The New Permanent Magnet Alloys. *Electronics,* Vol. 9, May 1936, pages 30-32, 35. Use of the Ni-Al-Fe alloys is discussed. Demagnetization and energy curves are presented. The effect of heat on the coercive force, as compared with high Co and W steel, and the loss of magnetism when the materials are dropped, indicate marked advantages for the new alloy. 7 patent references. DJM (11b)

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Electrical resistance of Faraday's steel samples; measurement of dissolved gas and other observations on melting a Faraday sample in an electric reflection furnace. (Elektriskt ledningsmotstånd hos några av Faraday framställda stålprov; bestämming av gashalt och vissa iakttigelser gjorda vid omsmältning av ett Faradayprov i den elektriska reflexionsugnen) Carl Benedicks. *Jernkontorets Annaler,* Vol. 120, Mar. 1936, pages 99-124. The electrical resistance of 18 small samples of Faraday steel preparations was measured by a special method depending on determining the potential drop between two points on a plane surface lying between two other points through which a fixed current is flowing. The apparatus was calibrated to determine the effect of thickness and irregularities in the perimeter, and an accuracy of $\pm 1\%$ was attained. The results agree well with previous work, and with the author's formula that 1 at. % foreign constituent always has the same effect, but better agreement is obtained by assigning individual coefficients to each constituent. Au, however, gives exceptionally high values, and in one Rh alloy the values were exceptionally low and in the other exceptionally high. Pt increases the resistance 7 micro-ohms/cm./cm.^{2} for each at. %. Melting of one sample containing 0.77% C. and 0.24% Si, released H_2 equivalent to 0.0004%, and N_2 equivalent to 0.006% by weight. The reflection furnace, which concentrates the heat on one side of the specimen, was found to cause softening first in the main body leaving the corners intact till the end, which is the opposite of the behavior in an ordinary oven where the corners melt before the main body, because they are exposed to radiation from all directions. It was also observed that pure Fe does not wet the walls of the crucible when melted in a vacuum, while C steel does because the C reacts with MgO to set free Mg which alloys with the steel. See also *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 466R/10. HCD (11b)

The Influence of Special Elements on the Physical Properties of Cast Iron. J. W. Donaldson. *Foundry Trade Journal,* Vol. 54, May 28, 1936, pages 417-419, 423. Experiments carried out with Si additions up to 5% show the thermal conductivity to decrease as the Si content increases. This phenomenon only takes place so long as the graphite content remains constant, but when the amount of graphite is increased, there is a rise in the heat conducting value. Replacing Si by Ni causes an increase in thermal conductivity up to a maximum at about 3% Ni. In comparing the influence of special element additions on the thermal conductivities of cast Fe and steel, there are certain differences to be noted. In general the addition of Si, Mn, Ni, or Al to gray cast Fe is to produce a rise in its electrical resistivity. Additions of Co cause the resistivity to decrease, while with Cu the resistivity increases slightly to a maximum with 1% Cu and then decreases. General influence of Cr is to decrease the electrical resistivity of cast Fe. A systematic study of the influence of special element additions on the coefficient of thermal expansion of cast Fe has been made by Söhnchen and Bornhofen (*Archiv für das Eisenhüttenwesen,* Vol. 8, 1934, page 357). Partridge, in determining the influence of various metals on cast Fe, found that the form in which C is present greatly influences the magnetic properties. Graphite does not affect the hysteresis loss, but prevents the attainment of a very high magnetic induction. Ferrite gives low hysteresis loss and high permeability, while pearlite gives high hysteresis loss and low permeability. AIK (11b)

12. EFFECT OF TEMPERATURE ON METALS AND ALLOYS

L. JORDAN, SECTION EDITOR

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M. The purpose of this cooperation is to make readily available complete references to the literature of this subject. The Committee does not necessarily subscribe to the statements of either the author or the abstractor.

Nickel Steels at Low Temperatures. An investigation of the Impact Properties of the 2¼ Per Cent Steels. B. C. ALDRIDGE & GEORGE C. SHEPHERD, JR. *Metals & Alloys*, Vol. 7, June 1936, pages 147-152; July 1936, pages 185-192. Impact tests at temperatures from —75° F. to +70° F. are reported for A.S.T.M. V-notched specimens, A.S.S.T. keyhole notch specimens in various widths and Izod specimens. Results by different laboratories are correlated and conversion factors calculated to reduce all results to standard A.S.S.T. keyhole specimens. For brittle materials the shape of notch is of more influence than the cross sectional area but for tougher material the notch is of less effect and factors approach values calculated from the moments of inertia. Effects of heat treatment, location of specimens in or near welds, and the relation of notch to direction of rolling were studied. WLC (12)

Variation of Resistance and Structure of Cobalt with Temperature and a discussion of Its Photoelectric Emission. LOUIS MARICK. *Physical Review*, Vol. 49, June 1936, pages 831-837. X-ray diffraction patterns were obtained for Co in a camera designed for high temperature work. No crystallographic change for this metal has been observed in the region about 850° C. at which the change in the photoelectric emission has been reported. The α to β transformation is observed at 492° C. and no change in this transition temperature is detected by heating at 875° C. for a period of 55 hours. The variation of electrical resistance with temperature is extended to 1200° C. showing a change in slope occurring at the Curie point, determined as 1100° C. from these curves. An expansion of approximately 0.6% in the lattice edge is observed as Co is heated through the Curie temperature. No evidence of a reversion to the hexagonal form at 1015° C. has been observed. The temperature coefficient of expansion determined from these lattice measurements is $0.143 \times 10^{-4}/°$ C. and this agrees well with the macroscopic coefficient as determined by the usual methods. An explanation is suggested for the discontinuity in photoelectric emission reported at 850° C. WAT (12)

Continuous Contraction of Hot Valve Steels. JACOB FRIEDMAN. *Metal Progress*, Vol. 29, Mar. 1936, pages 70, 72. Describes irreversible contraction phenomenon noted in austenitic valve steel (Cr 13.0%, Ni 13.0%, W 2.0%, Si 2.0% and C 0.50%) when subjected to repeated heating and cooling. WLC (12)

Changes in Iron and Steel During Creep. C. H. M. JENKINS & G. A. MELLOR. *Metal Progress*, Vol. 29, Feb. 1936, pages 59, 80, 82, 84. See *Metals & Alloys*, Vol. 7, Jan. 1936, page MA 33L/6. . WLC (12)

Note on the High-Temperature Strength of Cast Iron Especially in Thin-Walled Castings (Beitrag zur Warmfestigkeit des Gusseisens unter besonderer Berücksichtigung von dünnwandigem Guss) W. H. UHLITZSCH & W. LEINEWEBER. *Archiv für das Eisenhüttenwesen*, Vol. 9, Oct. 1935, pages 185-192. The elevated temperature strengths of a series of C and alloy cast irons are reported in graphs and tables. Tests of 13 alloy irons showed that when Si, Ni, Cr, and Mo were present the rate of fall in strength with temperature was lowered. SE (12)

Replacing Chromium-Nickel-Molybdenum Steels with Chromium Molybdenum Steels for Parts working under Conditions Leading to Increased Thermal Embrittlement. P. B. MIKHAILOV-MIKHEEV. *Kachestvennaia Stal*, Vol. 4, No. 5, 1936, pages 19-21. In Russian. Steels containing 0.3% C, 0.7 Cr, 3.5 Ni, 0.5 Mo used for fastening turbine parts working above 370° C. after 400 hours exposure have their impact value reduced from 6.5 to 5 kg.m./cm.^{2} and after 2000 hours to 2.6 kg.m./cm.^{2} Cr steel containing 0.3 C and 1.0 Cr loses 40-50% of its impact strength after 2000 hours. Steels containing 0.26% C, 0.75 Cr, 0.5 Mo remain fully ductile (10.8 kg.m./cm.^{2}) even after 2000 hours at this temperature if the steels are not strained. If, however, they are strained their impact value is reduced to 9.6 kg.m./cm.^{2} after the same exposure. Brittle range for Cr-Ni steels is limited to 450°-500° C., above and below which no embrittlement is observed. Cr-Mo steel has no brittle range. (12)

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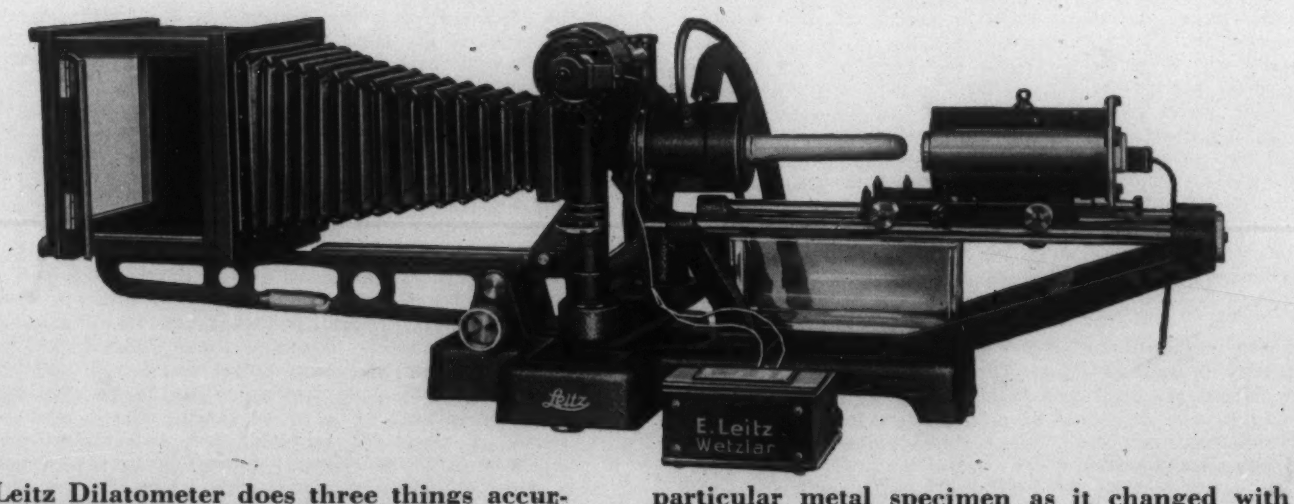

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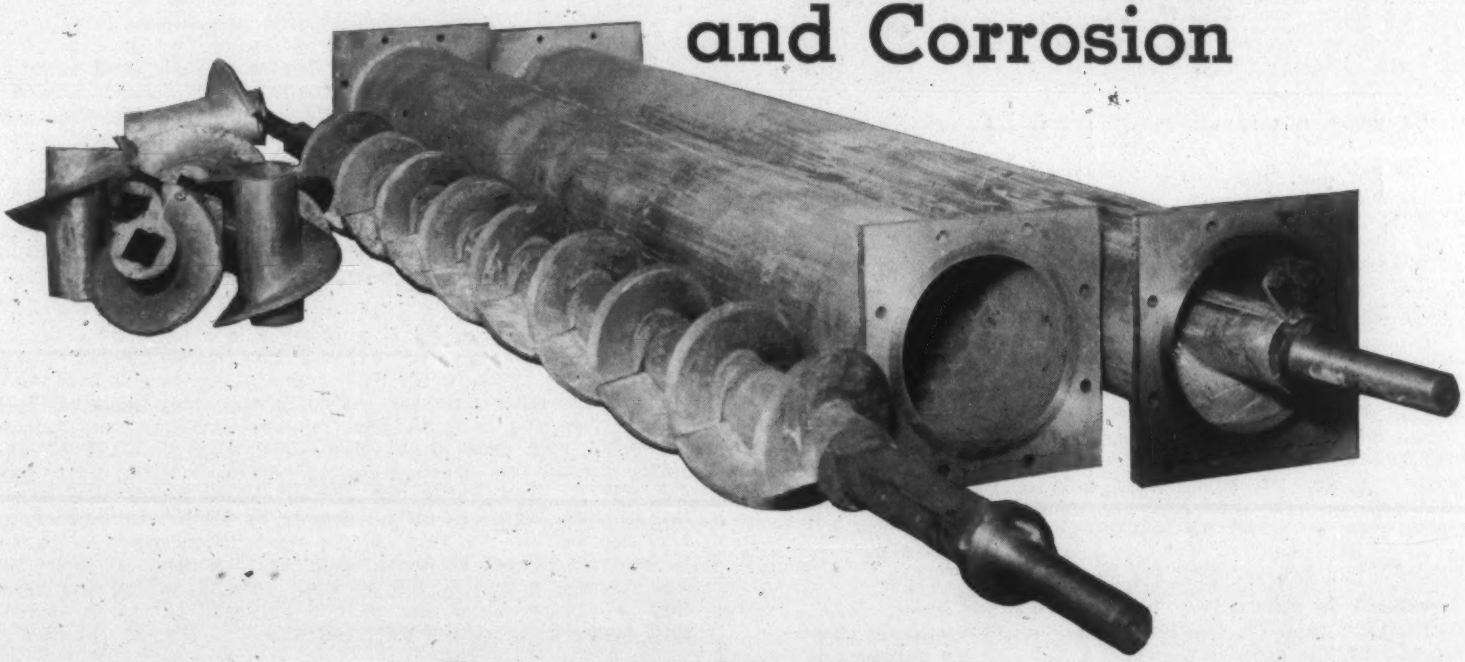

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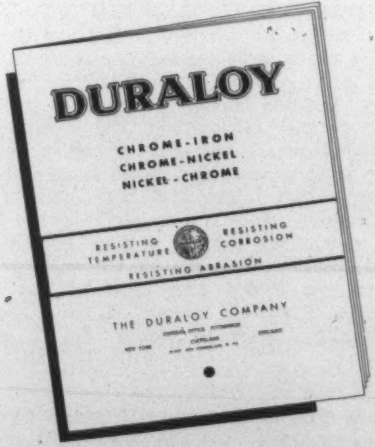

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13. CORROSION AND WEAR

V. V. KENDALL, SECTION EDITOR

Observations on the Oxidation of Steel. M. Baeyertz. *Transactions American Society for Metals,* Vol. 24, June 1936, pages 420-450. Paper presented and discussed at Chicago Convention of the Society, 1935. Study of the oxidation of plain C steels, S.A.E. 2330 and Cr steels with 5, 12, 17 and 27% Cr, 18-8 and 18-8 with 2.75% Mo shows oxidation to take place in a discontinuous manner caused by preferential oxidation of Si and Cr before oxidation of Fe. Stainless steels show the same general pattern of oxide forms as occur in other alloys but these similar oxide forms appear at different temperatures depending upon Cr content. The resistance of stainless steels to oxidation at high temperatures appears to be due to formation of 2 or more oxides high in Cr. WLC (13)

Galvanized Tank Corrosion on Automatic Water Heaters. A. F. Craver. *American Gas Journal,* Vol. 144, Apr. 1936, pages 29-32, 56; May 1936, pages 27-28. Causes of corrosion are divided into 3 groups: simple deterioration, external corrosion and contact corrosion. The presence of free O_2 in the H_2O leads to simple corrosion. External corrosion is caused by outside factors such as stray currents of radio grounds, etc. Contact corrosion results from the potential differences between unlike metals in contact with the same solution. Zn is electronegative to both Fe and Cu in the electrochemical series and is corroded when contact is made. A galvanized storage tank with brass and Cu fittings is therefore a galvanic cell. Agitation increases corrosion by causing more O_2 to be brought to the surface of the corrosing metal, by washing off the protecting film of H_2, and by loosening the protective coatings of alkaline salt and rust formations. Increase in temperature drives out the dissolved O_2 as nascent O_2 free to attack the corroding surface or to combine with the protecting film of H_2. Temperature also increases the electrical conductivity and produces greater localization of corrosion resulting in pitting. CBJ (13)

Metals in the Chemical Industry. Cecil H. Desch. *Chemistry & Industry,* Vol. 55, June 26, 1936, pages 169T-174T. An excellent treatise on the development of special metals and alloys for industrial use, brought about by increased corrosion problems in modern industry. Practically every metal and alloy is discussed, and the industry in which it is used to advantage. Corrosion fatigue and the impairment of physical properties, due to corrosion is fully explained and illustrated by graphical date. The otherwise well treated section on the effect of purity of metals on corrosion is marred by the misstatement of fact, viz., "99.99 Zn and Al when tested prove to be hardly attacked by HCl." AAA (13)

Electrochemical Mechanism of Corrosion (Der elektrochemische Mechanismus der Korrosion) U. R. Evans. *Korrosion & Metallschutz,* Vol. 12, May-June 1936, pages 105-107. At ordinary temperatures, the electrical current is the determining factor in corrosion by liquids. A direct chemical attack takes place only rarely. At high temperatures other conditions prevail as here the diffusion of O through the oxide layer must be considered. Recent experiments are reviewed which prove conclusively the electrochemical mechanism of corrosion. 16 references. Ha (13)

Corrosion Protection Value of Paint Films Indicated by Electrical Device. *Steel,* Vol. 98, June 29, 1936, pages 44, 46. Megohmeter is used for indicating effectiveness of organic finishes in excluding moisture. A lead from the instrument is connected to the bare side of a metal panel coated on the other side with a known thickness of paint to be tested. A drop of H_2O is placed on paint and a stop-watch is started. Other lead point is put into drop. Closing of circuit by penetration of H_2O through film will be indicated by galvanometer deflection. Time taken divided by film thickness in mils serves as an index of the corrosion-resisting ability of the paint film. MS (13)

Process Improves Corrosion Resistance of Zinc Surfaces. *Steel,* Vol. 98, June 1, 1936, page 43. Cronak process involves production of visible protective coating on Zn or Cd and on Zn and Cd plated metals, which materially reduces corrosion rate and prevents formation of white corrosion products. Film is produced by short immersion in an aqueous solution of $Na_2Cr_2O_7$ and H_2SO_4, and gives metal appearance similar to brass with a greenish-brown iridescence. Immersion of 5-10 sec. produces a brown coating on Zn alloy die castings. Immersion of 1-5 sec. produces a lighter iridescent coating. Tests indicate that process extends life of Zn coatings by at least 40%. MS (13)

"Go-Devils" and Radio Play Important Part in Cleaning Gasoline Pipe Line. *Oil & Gas Journal,* Vol. 34, Jan. 9, 1936, pages 28-29. Description of the cleaning of the Susquehanna Pipe Line Co., subsidiary of Sun Oil Co., gasoline pipe line from Marcus Hook, Pa., to Syracuse and to Cleveland. VVK (13)

The Work of the National Physical Laboratory. *Machinery,* London, Vol. 48, May 28, 1936, pages 259-260. Review of N. P. L. report for 1935 on contact corrosion under pressure, oxidation of solid metals, Mg, Al and Ca alloys for higher than room temperature use. WB (13)

Reconditioning An Old Water Main. Alfred B. Anderson. *Journal American Water Works Association,* Vol. 28, Aug. 1936, pages 1013-1016. Description of the cleaning and relining with cement of 5.5 miles of 48″ pipe of the water supply system of Newark, N. J. VVK (13)

Sucker Rod Breakage Can be Reduced by Use of Proper Design and Metal. Austin Allen. *Oil & Gas Journal,* Vol. 34, Feb. 27, 1936, pages 72A, 77A, 79A. Sucker rods are now designed for wells of the following types: (1) common rod for sweet oil only; (2) mild corrosion, medium weight; (3) extra strong for sweet oil only; (4) mild H_2S; and (5) bad H_2S. The various steels for these services are discussed and suggestions given for the care of sucker rods in storage, transportation, pulling and running. VVK (13)

Corrosion of Elektron Alloy AM503 by Leaded Fuels. Part I. Mechanism of Attack. G. D. Bengough & L. Whitby. *Journal Royal Aeronautical Society,* Vol. 39, Dec. 1935, pages 1144-1153. High anti-knock value fuels containing tetraethyl lead, corrode Mg-base alloy tanks so rapidly that such tanks cannot be used for leaded fuels. The mechanism of this corrosion is investigated as a preliminary step to developing protection methods. The alloy used contains max. 2.5% Mn, .2% each of Al, Zn and Cu, .4% Si, and the remainder Mg. The tests have been accelerated by increasing the amount of tetraethyl lead mix added to the gasoline as corroding medium, a procedure justified by the linear relationship between weight loss and volume % of the leaded mix. It is shown that (1) liquid water is essential to attack, (2) the separate constituents of the tetraethyl lead mix i.e. tetraethyl lead and ethylene dibromide, when added alone to gasoline and water, are not destructive. When mixed, however, intense attack occurs, (3) leaded technical benzol mixtures and water cause less attack than leaded straight run paraffin or napthene type aviation gas and water, (4) the dye is without effect on corrosion, (5) with constant water content, corrosion is directly proportional to the amount of tetraethyl lead mixture, (6) with constant tetraethyl lead mixture, corrosion rises to a maximum and then falls with increasing water content. FPP (13)

Corrosion and Protection of Metals in the New Patent Law (Korrosion und Metallschutz im neuen Patengesetz) E. Barth. *Korrosion & Metallschutz,* Vol. 12, July 1936, pages 177-178. Legal and technical principles in the new German law are explained. Patentability, procedure and infringement claims are discussed. Ha (13)

Electrolytic Contact Phenomenon of Commercial Steels (Contribution à l'étude des phénomènes électrolytiques de contact des aciers d'emploi courant) Georges Chaudron & Paul Lacombe. *Métaux,* Vol. 11, May 1936, pages 92-115. The improvement on the chemical and mechanical resistance of commercial steels by adding to these steels small amounts of metals such as Cu and Cr was investigated on 6 different steels containing 0.08-0.2% C, 0.5-0.8% Mn, 0.4-0.5% Cu and 0.4% Cr. When these steels were tested without the rolling scale on, the Cu steels were less electronegative than the C steels. With the rolling scale on, the Cu-Cr steels were more electronegative than the C steels. All tested steels have a dissolution potential of 0.7 volt in a 3% NaCl solution. GTM (13)

Motor Fuels and Corrosion (I carburanti e la corrosione) Sandro Doldi. *La Chimica e l'Industria,* Vol. 18, May 1936, pages 226-229. The corrosion of Al, Cu, bronze, Monel metal, mild steel and very hard steel in the presence of the following motor fuels was studied: alcohol, pure denatured, anhydrous, and hydrated; synthetic methanol, pure, denatured, anhydrous, and hydrated; gasoline d_{15}°-0.727; pure, S-free benzol, d_{15}° 0.860; crude benzol, d. 0.856, S-0.650%; spirits distilled from Ragusa shale, d_{15}° 0.840; S 3.0%; 97% distills between 65°-252° C. Results show that aqueous alcohols attack metal much more than the anhydrous; EtOH is not as corrosive as MeOH; the denatured alcohols are more injurious than the pure. Of the metals, Monel shows the highest resistance to corrosion; followed by bronze, brass, and hard steel; Al is the poorest. The least corrosive mixture is that of equal parts of gasoline and absolute EtOH. Next to gasoline, benzol free of S is the best. In general, alcohol gives very little trouble under ordinary conditions. AWC (13)

Report on Protective Coatings for Underground Pipes. A. B. Densham & F. C. Smith. *Institution of Gas Engineers, Copyright Publication* No. 115, 1935, 44 pages; *Gas World,* Vol. 103, Nov. 2, 1935, page 401; *Gas Journal,* Vol. 211, Sept. 11, 1935, pages 567-577. Accelerated methods for testing the efficacy of various protective coatings are described. Steel and wrought Fe service pipes corrode to much the same extent when exposed to electrolytic corrosion, so that both must be protected by a coating. Pitch troughing, bitumen asbestos sheathing, bitumen felt coating, bitumen hessian coating, thin adhesive bandage consisting mainly of hydrocarbon material (proprietary), and a bituminous paint (proprietary) covered with insulation tape all gave good protection against electrolytic corrosion. Pitch troughing in metal or cardboard moulds is an adequate method of protecting joints. Galvanizing, cotton fabric filled with grease (proprietary), cement troughing, and a bituminous paint (proprietary) applied over red Pb gave inadequate protection. The order of merit of the coatings investigated, judged from the electrical resistances, is roughly the same as the order judged from the amount of corrosion by an impressed current after 2½ years exposure. Probably the electrical resistance test gives a reliable measure of the protective power of a coating. 60 references. See also *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 469R/2. AHE + MAB (13)

Mechanism of the Dissolution of Iron and Steel in Nitric Acid of Various Concentrations. Hikozô Endô. *Kinzoku no Kenkyu,* Vol. 13, July 1936, pages 316-332. In Japanese. The mechanism of the dissolution of Fe and steel in HNO_3 of various concentrations was studied. According to the writer's opinion, the dissolution of Fe and steel in HNO_3 takes place in 2 processes, i.e. the electrochemical process, and the direct reaction of oxidation (direct dissolution). In dilute solutions the dissolution of Fe and steel occurs chiefly in the electrolytic process, i.e. the hydrogen evolution type, and subordinately in the direct reaction of oxidation, while in the case of concentrated solutions, it occurs chiefly by the direct reaction of oxidation. The writer conveniently divided the ranges of the concentration into 5 parts from the results of various experiments and the mechanism of the dissolution in each range of concentration was studied. The formation of various dissolution-products, such as NH_2OH, NH_3, N_2, N_2O, NO, HNO_2, NO_2 and complex salt of $[Fe(NO)](NO_3)_2$ in the solution of each range of concentration were also taken into consideration; and the decomposition of the products of HNO_2 and the complex salt were also confirmed from the experiments. In the solution of the concentrated range in which periodic dissolution occurs, the portion of the surface of specimen in contact with glass was markedly attacked in the shape of the glass rod; this was explained by the stability of complex salts formed at that part. KT (13)

Corrosion Mitigation on the West Coast. Lee Holtz. *Gas Age-Record,* Vol. 77, Apr. 18, 1936, pages 403-407, 409. Paper presented before American Gas Association Distribution Conference, Apr., Memphis, Tenn. A general review of the experiences of the Southern California Gas Co. A system of soil survey and analysis which classifies soil into groups according to their corrosive natures has been developed. Detailed soil maps are prepared and careful records kept. Considerable success has been obtained in the use of Cu pipe in heavy alkaline soils, wherein both cast Fe and protected steel have an average life of 9 years. Cu pipe seems to have an indefinite life. No trouble has been experienced at Cu-steel junctions from galvanic action caused by dissimilar metals, when the joint has been properly protected with asphalt for a distance of 3 ft. each side of the junction. Either coal tar or hot asphalts are used for protective coatings; cold applied coatings are considered money wasted since they can not be applied in sufficient thickness, are porous and allow moisture to penetrate the film and contact the pipe and are compounded with materials offering little resistance to the corrosive element of the soil. The latest coating developed consists of (1) one coat primer on sandblasted pipe, (2) one coat asphalt, 175° melting point, 20 normal penetration, 4.5 ductility, (3) two wraps cellulose base paper, (4) one coat asphalt, same as No. 2 above, (5) one wrap Kraft paper. Dehydration of gas removes corrosion trouble from the gas. The methods most commonly used for correcting stray current electrolysis are (1) bonding the pipe to negative return feeders installed by the railway companies, or bonding direct to the negative buss of substations and (2) installation of reversing switches and insulating flanges. VVK (13)

Influence of Light on the Electrode Potential and Corrosion Phenomena of Mild Steel. C. O. Bannister & R. Rigby. *Iron & Coal Trades Review,* Vol. 132, May 8, 1936, pages 852-853. See *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 470R/1. HA (13)

Theory of Corrosion Phenomena. IV. The Application of the Theory of Local Elements to the Problems of Corrosion (Zur Theorie der Korrosionserscheinungen. IV. Ueber die Anwendung der Theorie der Lokalelemente auf die Probleme der Korrosion) W. J. Müller. *Korrosion & Metallschutz,* Vol. 12, May-June 1936, pages 132-138. The correctness of the view that in the corrosion of metals, the formation of local elements between different places of the corroding metal is of primary importance is corroborated by a review of literature and the investigations of the author, and it is shown that the covering layer on a metal (film) plays a determining part. The distribution of the pores in this covering layer is about 10^9 pores/cm.^{2} surface; the metal in these pores is free and forms the anode of a local element in which the current flows back through the pores to the covering layer and the metal. On the strength of these observations, formulas are established by which the current and the amount of metal dissolved can be calculated. The thickness of the covering film is about 10^{-4} cm., and less in concentrated acids. 23 references. Ha (13)

Rapid Testing Method in Corrosion Investigations (Eine Schnellprüfungsmethode bei Korrosionsuntersuchungen) W. Palmaer. *Korrosion & Metallschutz,* Vol. 12, May-June 1936, pages 139-148. After a review of the theory of corrosion and testing methods for the attack of a metal, a new method is described which consists in covering the metal to be examined with a film of electrically good conductors of solutions of hygroscopic salts, as $CaCl_2$ or LiCl. The degreased and polished specimens are dipped in these solutions and suspended in a test tube which contains a few drops of the solution. The progress of corrosion can be observed with the eye and also determined by the loss of weight after certain periods. 14 references. Ha (13)

Influence of Oxygen on the Potential of Local Cathodes (Ueber den Einfluss des Sauerstoffs auf das Potential von Lokalkathoden) M. Straumanis. *Korrosion & Metallschutz,* Vol. 12, May-June 1936, pages 148-154. Local elements which are primarily responsible for metallic corrosion have only a low e.m.f. if O does not have free access to the element; however, the e.m.f. increases considerably and with it the corrosion velocity, if the O can get access easily. The reason for the increase is that H is bound to O as H_2O in the element and thus the decrease of H produces a nobler potential. 20 references. Ha (13)

Corrosion Fatigue of Drill Pipe. F. N. Speller. *American Petroleum Institute, Drilling & Production Practice,* 1935, pages 239-246, discussion pages 246-247. An investigation of the effect of mud fluids on the corrosion fatigue of drill pipe was initiated as a result of the exceptionally short life of a 4½″ grade D seamless drill pipe, apparently due to corrosion fatigue. The following conclusions were drawn. To avoid corrosion or corrosion fatigue on the outside of drill pipe, the metal should be protected from transverse scoring. It is also advisable to seal any openings at the joints as has been done by fusion welding. This practice not only prevents access of corrosive fluid, but also stiffens the joint so that it is stronger and there is less tendency for "rubbing" or "frictional" corrosion to develop. Contact effects and changes in velocity at the joints should be avoided as far as possible. The present practice of conditioning fresh-water mud, so that a high and stable colloidal content will be maintained, also protects the metal against corrosion and the chemical formation of notches under stress to a great extent. The alkalinity should be kept near the upper limit required for this purpose. To prevent corrosion, more field experimentation is desirable on the treatment of drilling mud. When soluble salts or other material are encountered that prevent satisfactory mud conditioning by their tendency to break down and flocculate the colloids, the useful life of metal under corrosion fatigue can probably be increased by reducing the free O with an excess of 100 to 200 p.p.m. of Na sulphite. If possible, this excess of sulphite should be maintained at all times and be controlled by tests at suitable intervals. Agitation of the mud-fluid stream in contact with air, and settlement of mud particles, both increase the rate of solution of O from the atmosphere. Therefore, particularly where de-oxidizing materials are added, the mud should not be agitated in contact with air more than is necessary. VVK (13)

Methods of Combating Corrosion and Electrolysis of Underground Lines. V. J. Sittel. *Oil & Gas Journal,* Vol. 34, Apr. 23, 1936, pages 46-47. Paper presented at the Petroleum Industry Electrical Association, Apr. 11, Tulsa, Okla. Any underground pipe line will have electric currents flowing on it caused by galvanic action of soil to iron pipe or by stray currents from railway or industrial power circuits. Protection by coatings is good only as long as the coating does not break down. Cathodic drainage maintained for 50% of the time will definitely check corrosion. .3 volt negative to the soil is necessary. VVK (13)

How many feet of Durimet tie-rod in this tank?

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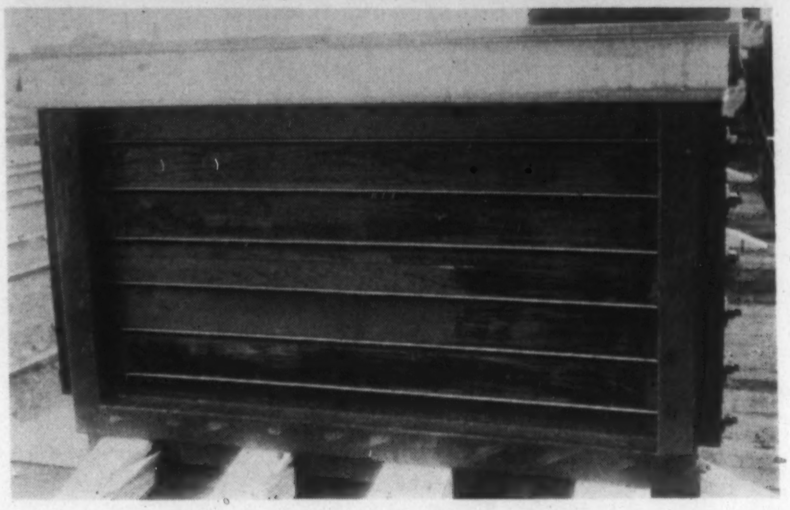

This Hauser-Stander pickling tank is approximately 6′ wide, 30′ long, 4′ high.

The tank is completely equipped with low-carbon (0.07%) Durimet ¾″ tie-rods, hex nuts, OG washers. For the tie-rods, four hundred and forty-nine feet, eight inches, was required, and one hundred and ninety each of nuts and washers.

The tank is to be used for a hot pickling solution containing ferric salts. That's why low-carbon Durimet is used—the usual alloy steels and non-ferrous alloys fail under such conditions.

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Electrolytic Corrosion in Imbedded Cast-iron and Steel Pipes, and Means Adopted to Reduce their Effect. I (Le corrosioni elettrolitiche nelle tubazioni interrate di ghisa e di acciaio, e i metodi adottati nella pratica per diminuirne l'entita. I) O. Scarpa. *La Metallurgia Italiana,* Vol. 28, June 1936, pages 257-267. Car tracks are subject to the corrosive action of stray currents. Varnishes, paints, etc. are not satisfactory protection, because they are readily scratched; coverings, such as with cement are very costly, and must be free of any flaws to protect. A good solution is to use double wires, so that the rail is not used as conductor. Good results have been obtained using a special insulator of bitumen, resin, or bitumen coated fabric between 2 layers of a fibre-containing cement. This insulator is being studied more fully. AWC (13)

Corrosion of Magnesium and Magnesium Alloys. Hachie Sawamoto. *Suiyokwai-Shi,* Vol. 9, July 1936, pages 39-46. The rate of corrosion of Mg and Mg-alloys in dilute acid and aqueous NaCl solutions were compared by the measurement of the gases evolved. From the experiments it is concluded that Cd is a desirable alloying constituent acting as anti-corrosive, but that it is less effective than Mn or Zn as reported in previous paper. HN (13)

Protection Against Corrosion of Iron by means of Arsenic (Korrosionschutz des Eisens durch Arsen) G. Tammann & H. Warrentrup. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 228, July 14, 1936, pages 92-96. As deposits on Fe and other metals are produced by heating in powdered As or by electrolytic methods. Smooth, bright deposit is possible with latter and fair protection against acid corrosion obtained with the As film. On bending, scratching or hammering the Fe plated with As, the As film breaks off and its protective value is lost. WB (13)

Wear Study of Hard Metals, Cast Iron, and Light Metals on the Wear-testing Machine of O. Nieberding (Abnützungsversuche an Hartmetallen, Gusseisen und Leichtmetallen auf der Abnützungsprüfmaschine von O. Nieberding) Reinhard Zimmer. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* No. 18, 1935, 68 pages. Hard materials such as WC had a very high wear resistance. Additions of up to 0.5% Cr and 1.3% Ni increased wear resistance of cast irons. Al alloys that age hardened at room temperature had the greatest wear resistance. A given Al alloy had the highest wear resistance in the fully age-hardened condition. Hardness did not vary directly with wear resistance as determined by the Nieberding machine. 14 references. JLG (13)

Corrosion from Products of Combustion of Gas. III. Tube Experiments (continued). James W. Wood & E. Parrish. *Gas World,* Vol. 103, Nov. 2, 1935, pages 404-405; *Engineering,* Vol. 140, Nov. 15, 1935, page 523; *Aluminium & Non-ferrous Review,* Vol. 1, Mar. 1936, pages 177-182. See *Metals & Alloys,* Vol. 7, Sept. 1936, page MA 471L/8.
JCC + LFM + AHE (13)

The Corrosion Problem in Steel. Andrew McCance. *Journal West of Scotland Iron & Steel Institute,* Vol. 43, Feb. 1936, pages 79-110. See *Metals & Alloys,* Vol. 7, June 1936, page MA 316R/7. FGN (13)

The Corrosion Problem in Steel. A. McCance. *Transactions Institution of Engineers & Shipbuilders in Scotland,* Vol. 79, Apr.-May 1936, pages 310-381. An excellent review of the nature of the corrosion of steel in the presence of water, with particular reference to the corrosion of ships' hulls. Mild steel, however it is made, and whatever impurities are present, is bound to corrode in aqueous solutions to a degree which depends only on the quantity of O which reaches the surface of the metal. Variations in the corrodibility of various solutions are largely due to differences in their power of dissolving O. Protection can only be afforded by removing dissolved O from the water or, when this is impracticable, by completely protecting the metal by a paint film. Incomplete protection, or the use of steels on which a partially protective film forms, may be very dangerous, as in these circumstances the total corrosion produced by the available O will be concentrated in a few areas and lead to dangerous pitting. The effect of mill scale on the corrosion of ships' plates is discussed and it is considered that the scale acts as such an O shield and this causes enhanced corrosion on the unprotected areas. No electrochemical action is thought to be involved in this case. The belief that modern steel corrodes more readily than pre-war steel is vigorously attacked, but it is pointed out that modern shipbuilding practice does not allow time for complete removal of the mill scale by weathering before painting, and may thus account for a difference in corrosion behavior of the hulls. A lengthy discussion is reported in which U. R. Evans contends that the conditions to which a ship's hull are subjected are different from those of total quiescent immersion and that considerations of corrosion velocities and corrosion probability in moving liquids lead to the conclusion that the tendency of localized corrosion and pitting varies very much from one variety of steel to another. The general opinion, supported by Bengough and others, appears to be against this conclusion. 51 references. See also *Metals & Alloys,* Vol. 7, June 1936, page MA 316R/7. JCC (13)

Topochemical Traits in Corrosion Phenomena (Topochemische Züge in den Korrosionserscheinungen) V. Kohlschütter. *Korrosion & Metallschutz,* Vol. 12, May-June 1936, pages 118-123. The definition of corrosion as "destruction of a solid body which is started on the surface by unintentional chemical and electrochemical attack" is discussed in all its ramifications and characteristics of the different types of corrosion are reviewed. It is attempted to establish a general morphology on the basis of the aggregate forms and disperse bodies as they are found in corrosion of solid bodies and crystals. The reaction of the corrosion products on the original condition of the attacked body is discussed and illustrated by the example of corrosion of Pb by air under pure water or dilute acids, on which the corrosion effects could be studied particularly well. Of special importance in the formation of reaction products are the so-called "somatoids" which are more or less regularly formed structures and can, under certain conditions, also be isolated. Somatoids as found in basic Al sulphite, Cu hydroxide, are reproduced in photographs. 10 references. Ha (13)

Modern Microscopy Technique in the Service of Corrosion Research (Die neuzeitliche Mikroskopiertechnik im Dienste der Korrosions forschung) A. Kufferath. *Korrosion & Metallschutz,* Vol. 21, July 1936, pages 171-175. New instruments, photographic papers and photographing methods used in determining defects and structures of metals and etching methods for making the structure more visible are reviewed. Ha (13)

14. APPLICATION OF METALS AND ALLOYS

Gasoline Pumps, Combining Beauty with Dependability, Are Mainly of Steel. *Steel,* Vol. 98, May 18, 1936, page 52. Describes pump made of rolled steel, semisteel castings, and die castings. MS (14)

Use of Hard Alloys for Drilling through Hard Formations. V. P. Bakul & M. M. Kratzov. *Redkie Metallui,* Vol. 5, Jan.-Feb. 1936, pages 16-26. In Russian. Drills tipped with Pobedit, a tungsten carbide alloy, drilled 4 times as fast through ferruginous hornblende as steel drills. Resharpening was required only 1/30 as frequently as with steel drills. HWR (14)

Compound Sheets and their Applications in Aeronautical Construction (Les tôles composées et leurs applications à la construction aéronautique) Robert V. Le Ricolais. *L'Aéronautique,* Vol. 18, Feb. 1936, pages 25-28. "Isoflex" sheet resembles corrugated cardboard and is made by reinforcing a thin flat metal sheet with another corrugated sheet which is welded in place using automatic equipment. The use of this material in aero construction is discussed. JCC (14)

Recent Developments in the Metallurgy and Application of Nickel Alloys. Robert C. Stanley. *Sheet Metal Industries,* Vol. 10, Apr. 1936, pages 293-295. General discussion of use of Ni in Ni alloy steels, Ni alloy irons, Monel, Inconel, etc. AWM (14)

Material for Chemical Pumps. C. H. S. Tupholme. *Chemical Industries,* Vol. 38, June 1936, pages 575-576. A brief survey of some of the metals and alloys used in pumps for handling chemicals and corrosive liquids. RAW (14)

Standardized Materials and Possibilities for their Employment (Genormte Werkstoffe und deren Anwendungsmöglichkeiten) E. Eichwald. *Automobiltechnische Zeitschrift,* Vol. 39, June 25, 1936, pages 297-302. The importance of standardized materials for the German metal industries because of scarcity of alloying metals in domestic production is commented on and an extensive list of ferrous and non-ferrous alloys compiled giving composition and stating the purposes, tools and engine parts for which they are particularly suitable. Ha (14)

■ 14a. Non-Ferrous ■

G. L. CRAIG, SECTION EDITOR

High-Duty Bearings for Heavy Loads. *Journal of Commerce, Shipbuilding & Engineering Edition,* Aug. 20, 1936, page 3. A discussion on the lining of high speed oil engine bearings with Pb bronzes on steel vs. Cu backs. 2 types of Pb bronze are used, one containing Cu with 10-45% Pb, usually 30%; and the other containing Cu, 5-10% Sn, and 10-25% Pb. The former has a Brinell hardness of 32 to 34 and the latter a hardness of 42 to 45. Crankshafts used in conjunction with those bearings should have a minimum Brinell hardness of 250 and 300 respectively. JWD (14a)

Fast Motor Launch of Aluminium Alloy. *Shipbuilding & Shipping Record,* Vol. 48, July 2, 1936, page 20. Description of a 35 ft. motor launch in which the hull has been constructed of salt-water-resisting Al alloy. Several fittings are also made in Al, as well as the base and housing for the six-cylinder engine.
JWD (14a)

New Copper House. *Metal Industry,* New York, Vol. 33, Oct. 1935, pages 352-353. Outside walls, roof and roofing accessories, plumbing lines, heating lines, radiation, and hardware are Cu or Cu alloys. The house is weather-proof, rust-proof, fire-proof, lightning-proof, sound-proof and termite-proof. CBJ (14a)

High Production Methods for Manufacturing Anodized Aluminum Alloy Pistons. *Metal Industry,* New York, Vol. 34, Mar. 1936, pages 103-104. Equipment for machining anodized pistons is described. Inspection is carried out in an air-conditioned constant temperature room. Inspection devices are described. CBJ (14a)

Light Metals in Railway Stock (Les métaux légers dans le matériel de chemin der fer) *Les Chemins de fer et les Tramways,* Paris, July 1935, page 184. For 12 years La Compagnie du Chemin de Fer du Nord has used light metals for the construction of railcars. Great reduction of weight has been achieved due partly to making use of the system of articulated cars. The total weight of one train does not exceed 82 tons and is 50 tons less than 3 normal cars of same capacity.
HR (14a)

Non-ferrous Alloys Available for the Use of Industry. Hiduminium and Magnesium Alloy Extruded Rod and Drawn Sections. *Aluminium & the Non-Ferrous Review,* Vol. 1, June 1936, pages 417-418. Gives detaails of the following alloys: Hiduminium "RR 56," "DU," "72," and "RR 66"; and Magnuminium "266." JCC (14a)

Tin-plate Beer Containers—Tin Consumption Estimated at 2100 Tons. M. W. von Bernewitz. *Chemical Engineering & Mining Review,* Vol. 28, June 8, 1936, page 304. The cans are lacquered inside and lithographed outside.
WHB (14a)

The Application of Light Alloys in General Engineering Design. G. A. Clavey. *Transactions Institution of Engineers & Shipbuilders in Scotland,* Vol. 79, Mar. 1936, pages 238-255. Includes discussion. The physical properties of some representative light alloys are tabulated and compared with those of iron and steel. Special characteristics are briefly discussed and the case presented for their greater use in engineering design. JCC (14a)

Aluminum Powder Paints (Les Peintures à la Poudre d'Aluminium) H. Rabaté. *La Revue Industrielle,* Vol. 66, May 1936, pages 177-180. Discussion of methods employed for the production of Al powder and types of suspension media used in paint manufacture. FR (14a)

Italian Experiences with Telephone Lines (Italienische Erfahrungen mit Fernmeldeleitungen) G. Dasetto. *Aluminium,* Vol. 18, June 1936, pages 253-256. Lines of pure Al and more recently aldrey have been substituted for bronze or galvanized steel with good success. Tables with comparative electrical and mechanical properties of materials used in Italian telephone service are given. Ha (14a)

The Cast-Aluminum Base Denture. Dayton Dunbar Campbell. *Journal American Dental Association,* Vol. 23, July 1936, pages 1264-1270. The alloy used is one of Al and Mg (3.75% Mg) and designated by the producers as Alcoa No. 214. The author gives 5 reasons for the superiority for Al-Mg alloy denture: (1) Al is the only self-cleansing denture base material, (2) Al ranks highest among the usable metals, (3) Al may be permanently dyed the hue or color closely approximating that of gum tissue, (4) Al is the least expensive of all denture base metals, (5) Al denture base construction presents no greater difficulties than the cast Au inlay. The cost of metal for casting a base is about 5 cents where Au would cost 700 times as much. The author claims higher strength for the cast Al base and that the castings are so accurate swaging is not required. OEH (14a)

Filling Root Canals with Silver Points. Louis I. Grossman. *Dental Cosmos,* Vol. 78, July 1936, pages 679-687. The author finds Ag points more convenient to use than other materials which have been used to fill root canals and at the same time recognizes that it may have a degree of bacterial, inhibition through the oligodynamic effect. As a cementing material, he advocates a silver cement made of a powder containing 2 parts of precipitated Ag, 3 parts of powdered rosin, and 4 parts of ZnO (C.P.) which is mixed with a liquid of 9 parts of eugenol and 1 part of 4% solution of $ZnCl_2$., 35 references. OEH (14a)

Manifold Usefulness of Aluminum Powder (Die vielseitige Anwendbarkeit des Aluminiumpulvers) E. Hermann. *Aluminium,* Vol. 18, Aug. 1936, pages 376-381. The many possibilities of using Al powder in paints, as corrosion protection by tar-Al powder coatings, as light reflecting signs, for decorative purposes, heat-resistant and water-proofing coats, in pyrotechnics, etc., are reviewed and illustrated. Ha (14a)

Silver and its Uses in Chemical Plant. Arthur Haslam. *Metallurgia,* Vol. 14, July 1936, page 59. A brief review. JLG (14a)

Study of the Causes of Discontinuity of Metal in Sprues During Pressure-Casting. Raymond E. Myers. *Journal American Dental Association,* Vol. 23, Apr. 1936, pages 554-568. From many laboratory experiments, the author concludes that the discontinuity of metal in sprues during pressure casting is caused by the following conditions, either separately or in combination: (1) insufficient pressure to complete the casting; (2) insufficient heating of the casting metal, allowing the residue button to solidify before the pattern chamber and sprue are filled; and (3) insufficiency in amount of surplus metal to keep the sprue filled during the casting operation. The metal used in the experiments was a standard inlay gold, 3 to 5 pennyweights being used in each test. Extensive data are given and typical cases are illustrated by photographs. OEH (14a)

14b. Ferrous

M. GENSAMER, SECTION EDITOR

Heat-, Rust- and Acid-resisting Steels. W. H. Hatfield. *Iron & Coal Trades Review,* Vol. 132, June 26, 1936, page 1147. Present types of heat-resisting steels include (1) plain Cr steels (12-30% Cr), (2) Si-Cr steels, (3) austenitic Cr-Ni steels, Cr and Ni each up to 30% with or without W and Ti and (4) higher Ni-Cr alloys, e.g. 60% Ni, 20% Cr. Chemical compositions and mechanical and physical properties of these groups and fields of their application are given in tables. Ha (14b)

Bath Tub Manufacture is Revolutionized. J. B. Nealey. *Industrial Gas,* Vol. 14, June 1936, pages 18-19, 24-25. Bath tubs are pressed of sheets of 99% pure Fe, pickled and coated with vitreous enamel of same expansion as the metal. Weights are thus reduced from 375-425 lbs. to 98-125 lbs./tub. Ha (14b)

Gage of Metal for Enameling. Charles S. Pearce. *Metal Progress,* Vol. 30, July 1936, page 63. Chipping of vitreous enamel on sanitary ware is blamed on the light sheet metal used. All stresses with the metal in service or installation must be within its elastic range. WLC (14b)

Cutlery Industry. D. A. Palmer. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XVII. Reviews history and development. Pays some attention to use of stainless steel. MS (14b)

Low Carbon, High Chromium Alloy perfected in France. Albert Portevin. *Metal Progress,* Vol. 29, June 1936, page 70. 17-18% Cr steel with less than 0.10% C works very easily for making stampings. WLC (14b)

Machining Both Ends of Cast Iron Pipe in One Operation. I. S. Raidel. *Canadian Machinery,* Vol. 47, May 1936, pages 23-24, 56. Description of method of making precise, metal to metal joint in cast pipe which may then be joined at any angle with good fit due to tapered machining. WB (14b)

Stainless for Aircraft Design and Fabrication. Wilson L. Sutton. *Metal Progress,* Vol. 29, June 1936, pages 40-44. On a weight-strength basis there is little to choose between duralumin and stainless but the latter is more applicable to large structures and heavier loads. Welding technique in aircraft construction is discussed. WLC (14b)

15. GENERAL

RICHARD RIMBACH, SECTION EDITOR

The Chemists' Year Book. 1936. Founded by F. W. Atack. Edited by E. Hope. Chemical Publishing Co., New York, 1936. Fabrikoid, 4 x 6¼ inches, 1,257 pages. Price $6.00.

The editorial control of this British yearbook changes with the present edition from Dr. Atack to Dr. Hope. The sections of the book of special interest to metallurgists are: Thermal Constants of Elements; Physical Constants of Elements and Alloys; Melting Points of Some Special Alloys; Crystallography; Properties of Minerals; Spectrum Analysis; Fuels and Illuminants; Lubricants; and Analysis of Clays, Firebricks and Silica Materials. R. Rimbach (15)—B—

Better Returns from Scrap. E. G. Wertheimer. *Metal Industry,* New York, Vol. 33, Sept. 1935, pages 316-318. Industrial non-ferrous metal scrap can be classified as follows: (1) Scrap from production departments, (2) scrap from maintenance operations, (3) scrap from dismantling operations. Scrap from production includes (a) borings and turnings from machining operations, (b) skeletons, clippings, and short ends from punching and shearing operations, (c) solids found defective during course or completion of all operations, (d) metallic residues, skimming drosses, etc. accumulated through certain meltings or plating operations, and (e) certain classes of non-ferrous metals used to process production items. Items of importance in scrap selection and preparation are discussed. CBJ (15)

Research Activities of Mellon Institute Reach Quarter-Century Mark. E. R. Weidlein. *Steel,* Vol. 98, Apr. 20, 1936, pages 61, 94. Excerpt from 1935-1936 annual report, dealing with advances made at the Institute in heat insulation, refractories, and ferrous metallurgy. MS (15)

Simplify Proposed Color Code for Marking Steel Bars. *Steel,* Vol. 98, June 15, 1936, pages 37, 40. Deals with development of revised code approved by the National Association of Purchasing Agents and tabulates colors and color combinations decided upon to identify various S.A.E. steels. MS (15)

Index and Directory to the Manufacturers of Fabricated Parts and Aircraft Materials. *Aero Digest,* Vol. 29, July 1936, pages 66, 70. WB (15)

Cyanide Poisoning. K. K. Chen, C. L. Rose & G. H. A. Clowes. *Metal Industry,* New York, Vol. 34, Sept. 1936, page 346. Precautions for handling cyanides are listed. CBJ (15)

15a. Economic

Zinc Industry in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 446, Mar. 31, 1936, 3 pages. Statistical. AHE (15a)

Rolled Zinc in 1935—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 448, Apr. 23, 1936, 2 pages. Statistical. AHE (15a)

Tool Steel. William F. Osborn. *Times [London] Trade & Engineering,* Vol. 38, Apr. 1936, page XXVIII. Discusses briefly adoption of new methods by the tool-steel industry of Sheffield, England, and its part in British national economy. MS (15a)

The Swedish Steel Industry. H. Dahlerus. *Iron & Coal Trades Review,* Vol. 132, Apr. 24, 1936, page 752. After some historical data of the development of the Fe and steel production in Sweden, modern production statistics are given. Charcoal pig Fe is still the fundamental element in the quality of Swedish steel. Fairly poor ores are used which are finely crushed and concentrated; by sintering the concentrates the S content is considerably reduced. As the charcoal pig Fe is practically free from P, S and Cu it is particularly well adapted for steel-making. The acid open hearth is mainly employed for high-grade steels, the basic process is used for the manufacture of commercial steel. Electric furnaces are now used of capacities of 20-25 tons, the principal types being the arc furnace and, lately, the high-frequency furnace. Ha (15a)

The Usurpation of Patents in Spain (La usurpacion de patentes en Espana) Ramon Pella. *Metalurgia y Construccion Mecanica,* Vol. 2, July 1936, page 8. The lawyer explains to the engineer how to proceed to protect his patents in Spain. FPM (15a)

15b. Historical

From the History of Aluminum (Aus der Geschichte des Aluminiums) M. H. Haas. *Aluminium,* Vol. 18, July 1936, pages 332-348. Biography of Martin Kiliani, who developed the electrolytic production of Al in Germany, is given. Ha (15b)

Historic Sources of Foundry Practice. S. O. Birula. *Liteinoe Delo,* Vol. 7, No. 5, 1936, pages 16-23. In Russian. (15b)

Fiftieth Anniversary Marks Progress in Casting Aluminum. H. J. Rowe. *Foundry,* Vol. 64, Feb. 1936, pages 22-24, 63-64, 66, 69. Gives historical review of the Al industry from Charles M. Hall's discovery of the electrolytic process of Al manufacture to the present time. VSP (15b)

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MARKET RESEARCH SPECIALIST with a good technical background. Complete developing and marketing experience on electrical and chemical specialties and instruments. Salary or fee basis. Box MA-9, METALS & ALLOYS, 330 West 42nd Street, New York, N. Y.

AVAILABLE — METALLURGIST — Technical graduate—35 years—8 years metallurgical supervision over all phases of special steel manufacture, including melting. Address Box MA-11, c/o METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

REPRESENTATIVE WANTED: Industrial furnace manufacturer wants experienced sales engineer familiar with middle west territory and with some metallurgical knowledge. Commission basis. Address Box MA-12, c/o METALS & ALLOYS, 330 West 42nd Street, New York, N. Y.

WANTED: By large, well-known buyer of Metal Alloys and Residues containing Nickel, Chrome, Etc.—Representatives who are acquainted with the Steel—Chemical—Heat Treating, Heat Resisting, and Automobile Industries. We offer a very attractive proposition to the right man. Reply, giving references and qualifications. Also, cities and states which you cover. All references and qualifications will be kept strictly confidential. Box MA-13, METALS & ALLOYS, 330 West 42nd Street, New York, N. Y.

WELDING ENGINEER, metallurgical experience with sales background. Experience in design, estimating and research, sheet metal and heavy structures. Not actively employed at present. Permanent connection desired. Box MA-14, care of METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

METALLURGIST, immediately available. Technical graduate, studied under Dr. Albert Sauveur and Dr. V. N. Krivobok. 3 years of practical experience in research on failures, development and plant control of alloy and plain carbon steels. Also 3 years of experience in ore dressing and mining engineering. Single, 33 years of age, no preference to location. Address Box MA-15, METALS & ALLOYS, 330 W. 42nd St., New York.

METALLURGIST available. A young Dutch metallurgist, now employed in the laboratory of a machine and chain works in Holland, wants to get a chance in the U. S. A., with opportunities for increased responsibility and salary. Box MA-16, METALS & ALLOYS, 330 W. 42nd St., New York.

METALLURGIST desires position in applied research, ferrous preferred. Thoroughly experienced in metallography, X-rays, physical testing, etc. Experience gained in research laboratories, steel plants, and field. Employed. Box MA-19, METALS & ALLOYS, 330 W. 42nd St., New York.

METALLURGIST, *Physical Chemist*: Ph.D. '31, age 33. Five years' experience in physical metallurgy—corrosion, metallography, heat treatment and finishing of stainless and alloy steels. Practically familiar with newest methods of testing and investigation in metallurgy. Can initiate and direct research. Employed, available on short notice. Box MA-18, METALS & ALLOYS, 330 W. 42nd St., New York.

SALES ENGINEER with an established Chicago office desires a steel and alloy tubing account—for territory covering Illinois, Wisconsin, Indiana and Southern Ohio. Box MA-17, METALS & ALLOYS, 330 W. 42nd St., New York.

MANUFACTURERS' LITERATURE

Oven Furnaces

The line of improved oven furnaces is described in an illustrated leaflet which lists the desirable features to be found in these ovens. American Gas Furnace Co., Elizabeth, N. J. (1260)

Temperature Control

An all electric automatic control which operates on the radio principle is described in an illustrated leaflet. The manufacturer claims that this principle makes possible the most dependable and closest automatic control available today. Wheelco Instruments Co., Chicago, Ill. (1261)

Ajax-Northrup Electric Furnaces

Bulletin No. 10, devoted to the oscillator or spark-gap type converters and furnaces supersedes Bulletin 7. General principles of this equipment are discussed. Illustrated. Ajax Electrothermic Corp., Trenton, N. J. (1262)

A New Motorblower

Type CS Motorblower which was designed to meet the needs of the services requiring air at one-pound pressure in volumes from 325 to 3200 cubic feet per minute is described and illustrated in a pamphlet distributed by Ingersoll-Rand, New York, N. Y. (1263)

High Temperature Insulation

For all types of heated equipment is the subject of an illustrated leaflet issued by Armstrong Cork Products Co., Lancaster, Pa. (1264)

Repeated Stress Machines

These machines for determining the endurance limits of bar, wire and sheet metals are illustrated and described in a pamphlet which claims speed, accuracy, economy and convenience as their chief features. G. N. Krouse, New Kensington, Pa. (1265)

Stainless and Heat-Resisting Steels

A colorful booklet devoted to the Enduro line of steels illustrates many of the applications. Tables of the properties of these steels and laboratory corrosion data are included. Republic Steel Corp., Massillon, O. (1266)

Rapid Grinding Manual

This manual, GM-36, describes and illustrates the complete procedure of the latest technique for rapid, economical grinding of Carboloy tools. It is recommended as a practical instruction booklet for all carbide tool users. Carboloy Co., Inc., Detroit, Mich. (1267)

Scientific Metal Cleaning

Solvent degreasing and alkali cleaning are discussed in this illustrated booklet. Three basic types of degreasing machines—vapor, immersion and spray—are described. Detroit Rex Products Co., Detroit, Mich. (1268)

Ladle Fluxes

The advantages of using fluxes for aluminum, brass, bronze, copper nickel, iron and special alloys are listed in a leaflet of The Maluminum Co., Indianapolis, Ind. (1269)

Vanadium Steels for Locomotive and Car Construction

For each type of steel discussed this comprehensive booklet provides tensile properties under recommended methods of heat treatment and considers the relationships of these properties to the applications suggested. Illustrated. Vanadium Corp. of Amer., New York, N. Y. (1270)

Zinc Alloy Die Castings

This supplement of "A Visual Report of Progress" brings the progress being made in the die casting industry up to date. These photographs were intended as a cross section of die casting ideas. The New Jersey Zinc Co., New York N. Y. (1271)

Silicon-Chromium-Molybdenum Steels

A booklet devoted to Sicromo 1, 2, 3 and 5 steels, gives the analyses of the steels and discusses the effect of both silicon and chromium on the oxidation resistance of steels in which they are used. The Timken Steel & Tube Co., Canton, Ohio. (1272)

Metal Surface Preparation

This manual outlines the procedure to be followed for the various applications of sodium cyanide in the preparation of metal surfaces. E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (1273)

Combustion Safeguard

A materially improved line of Protectoglo equipment is described in Bulletin No. 90-1. This apparatus includes two separate and distinct types of relays, and a flame sensitive electrode which can also be used as a special spark plug for electric ignition. The Brown Instrument Co., Philadelphia, Pa. (1274)

Molybdenum in Steel

Data on different types of molybdenum steels are given in an illustrated booklet of the Climax Molybdenum Co., New York, N. Y. (1275)

Chain and Belt Conveyors

Bulletin 1-B discusses conveyors for use at high temperature. The advantages of this company's products are described and the capacities of the chain and belt conveyors given in tables. Michigan Steel Casting Co., Detroit, Mich. (1276)

Electric Furnaces

Bulletin No. 51 describes a few of the furnaces manufactured by this company. This equipment, although it covers a fairly wide range of manufacturing requirements, represents only a small portion of this company's furnaces. C. I. Hayes, Inc., Providence, R. I. (1277)

Temperature Control Instruments

Bulletin No. 456 is devoted to this company's pyrometer controllers. Illustrated. The Bristol Co., Waterbury, Conn.

Published by the same firm: Bulletin 457 is devoted to this company's Pyrotrol which is a safety device for gas-fired industrial ovens and furnaces. (1278)

Bearing Bronzes

A leaflet of interest to engineers lists the methods used to eliminate oxides from the finished product. Tables to aid in the choice of the proper alloy are included. The Johnson Bronze Co., New Castle, Pa. (1279)

Where and How to Prevent Corrosion

Bulletin L-36 discusses the use of certain of this company's compounds as rust-preventives and indicates formulae to be used and results obtained. The materials are manufactured from fractions of petroleum by means of a process of controlled oxidation. Alox Corp., Niagara Falls, N. Y. (1280)

Industrial Applications of the X-Ray

The application of X-ray examination to castings, welding and food products and X-ray diffraction are discussed in some detail in the profusely illustrated publication 8A-54 of the General Electric X-Ray Corp., Chicago, Ill. (1281)

Turbo-Compressor Data Book

This Data Book No. 107 was prepared to give accurate and brief information on the engineering characteristics of turbo blowers and exhausters. General information on the application of this company's blowers to gas and oil burners, and miscellaneous applications for other types of work are included, as well as rating tables. Illustrated. The Spencer Turbine Co., Hartford, Conn. (1282)

Testing Machines

Catalog 50, Part L, features Olsen Universal testing machines. Complete descriptions and illustrations. Tinius Olsen Testing Machine Co., Philadelphia, Pa. (1283)

Heat in Industry

A well illustrated booklet entitled "Wherever Heat is Used in Industry" gives a picture of this company's products and service. According to this booklet their equipment is being used, and giving the highest degree of efficiency in heat treatment of metals, manufacturing glass, enameling, etc. Surface Combustion Corp., Toledo, O. (1284)

Forging Rolls

Bulletin No. 91 claims that these wide adjustment forging rolls are completely modernized machines with improved mechanical operation, increased economy and efficiency of this forging method and improved quality of the product. Ajax Manufacturing Co., Cleveland, O. (1285)

Micromax Thermocouple Pyrometers

A new catalog, N-33A, explains the potentiometer method of measurement, the operation of the mechanisms through which this balance method is made available to industry. The complete line of instruments is set forth. Leeds & Northrup Co., Philadelphia, Pa. (1286)

Polishing Machines

A portable model and a floor model of these new metallographic machines are described and illustrated in a pamphlet from Eberbach & Son Co., Inc., Ann Arbor, Mich. (1287)

Heavy-Duty Black

Triple-A No. 20 heavy-duty black is the full name of this coating for steel which, according to the manufacturer, resists acids, alkalies, brine, moisture, abrasion and sulphurous fumes. Quigley Co., Inc., New York, N. Y. (1288)

Furnace Element Construction

Bulletin HD-636 describes the development of the Hevi Duty element construction in furnaces. Some of the features of these elements are: freely radiated heat from the heating coils; coils are free to expand and contract; and tolerances are allowed for the free expansion of the radiant plates and tee supports and for normal growth of the coils. Hevi Duty Electric Co., Milwaukee, Wis. (1289)

MANUFACTURERS' LITERATURE

Finishes for Aluminum

Characteristics of aluminum, mechanical finishes, chemical dip finishes and electrolytic oxide finishes are among the features of an attractively illustrated booklet. Aluminum Co. of America, Pittsburgh, Pa. (1290)

X-Ray and the Foundry

Interesting treatise on this subject setting forth how the X-ray has now come to the fore as a tool of the testing laboratory. Kelley-Koett Mfg. Co., Inc., Covington, Ky. (1291)

Cor-Ten and Man-Ten

Pamphlet describing high-tensile steels developed to meet the needs of the transportation industry. United States Steel Corp., Pittsburgh, Pa. (1292)

Extensometer

The Kenyon-Burns-Young extensometer is described and illustrated in Bulletin 128. It is claimed that this equipment determines the deep drawing qualities of sheet metal accurately. Illustrated. Baldwin-Southwark Corp., Philadelphia, Pa. (1293)

What Scientists Say of Leitz Ultropak

Bulletin No. 17 describes the personal experiences and applications to which Ultropak has been placed by scientific workers in various fields. E. Leitz, Inc., New York, N. Y. (1294)

Heat and Corrosion Resistant Alloys Heated By Gas

Bulletin C1-A illustrates a number of complex castings made from Q-Alloys which are recommended for pipe fittings, furnace parts, etc. General Alloys Co., South Boston, Mass. (1295)

Special Atmospheres in the Heat Treatment and Brazing of Metals

A reprint of the above article by C. L. West, Research Engineer, is offered by The Electric Furnace Co., Salem, O. (1296)

Wet Patch

The manufacturer claims that excellent results are obtained when P. B. Sillimanite wet patch is used to patch crucible furnaces, electric furnaces, etc., because of its high refractoriness negligible shrinkage and stubborn resistance to slag attack. The Chas. Taylor Sons Co., Cincinnati, O. (1297)

Sand Control in the Foundry

A colorful pamphlet lists the major causes of casting defects and inferiorities and states that they may be avoided by the use of the proper sand control equipment. Illustrated. Harry W. Dietert Co., Detroit, Mich. (1298)

Silico-Manganese Spring Steel

Extreme care is taken in processing this steel to avoid imperfections, in rolling to obtain cold-shearing qualities and in controlling the uniformity of the structure to insure both high inherent fatigue resistance and uniform heat treating characteristics, according to the manufacturer. Illustrated. Bethlehem Steel Co., Bethlehem, Pa. (1299)

Salt Bath Furnace

The Ajax-Hultgren electrically heated salt bath was designed to meet the metallurgical requirements of liquid heat treating operations. Bulletin 103 lists some of the advantages of the furnace. Illustrated. Ajax Electric Co., Inc., Philadelphia, Pa. (1300)

Screw Steel

A recent development in the production process of Union free cut, Bessemer (S.A.E. 1112) largely eliminates abrasive elements associated with wear on cutting tools. Longer tool life and uniformity of the steel are claimed among its advantages. Union Drawn Steel Co., Massillon, O. (1301)

Stainless Steel Castings

An attractive booklet contains useful information on the subject. Typical analyses, characteristics and suggested uses are listed. Joseph T. Ryerson & Son, Inc., Chicago, Ill. (1302)

Heavy Duty Refractories

This handbook contains complete descriptions, applications, tables and illustrations of standard shapes. Many useful engineering data are included. Norton Company, Worcester, Mass. (1303)

Braze-Rite Furnace

This furnace, developed principally for brazing sintered carbide cutting tools, provides for localized heat to be applied only to the portion of the tool to be brazed. Illustrated. Firth-Sterling Steel Co., McKeesport, Pa. (1304)

The New Arc Welding Technique

The new "Shield-Arc S.A.E." Welder which is described and illustrated in a colorful pamphlet gives an arc to suit every application according to the manufacturer. At any desired value of welding current, a wide variation in penetration can be secured, permitting the desired quality of weld with greater welding speed. The Lincoln Electric Company, Cleveland, O. (1305)

Fluxing, Deoxidizing and Hardening Alloys

Ajax alloys (phosphor copper, phosphor tin, nickel copper, manganese copper and silicon copper) are the subjects of a new leaflet issued by the Ajax Metal Co., Philadelphia, Pa. (1306)

Electromet Review

This publication, whose purpose is to bring "News and Views of Alloy Steels and Irons" to the reader, contains interesting items. Electro Metallurgical Co., New York, N. Y. (1307)

Cable Accessories

Publication GEA-1839 lists and describes the materials required for work involving the jointing and terminating of insulated cable. Illustrated. General Electric Company, Schenectady, N. Y. (1308)

Properties of OFHC Copper

An attractive booklet contains reprints of three papers relating to the above subject. Photographs, diagrams and photomicrographs are used to illustrate them. United States Metals Refining Co., New York, N. Y. (1309)

Finish Baking and Drying Ovens

Ovens for various finishing processes are featured in two new bulletins, pages 101-104 of Section A-5, which have been issued by the Despatch Oven Co., Minneapolis, Minn. (1310)

Gas Fired Furnace

The manufacturer of the gas fired Lindberg Cyclone furnace for heating at temperatures from 250 deg. F. to 1400 deg. F. claims that the heating rate is remarkably fast, and either open or extremely dense charges are handled with equal facility. Illustrations. Lindberg Engineering Co., Chicago, Ill. (1311)

3300 Deg. Super Refractory

An illustrated catalog devoted to "Shamva" Mullite contains information regarding its background, characteristics and uses. Mullite Refractories Co., Shelton, Conn. (1312)

Electro-Granodizing

This process which, according to the manufacturers, provides a rust-proof, paint-receptive surface combining the advantages and eliminating the disadvantages of other protective coatings in commercial use today is described in an illustrated leaflet of the American Chemical Paint Co., Ambler, Pa. (1313)

Potentiometer Control Pyrometer

The principles, operating details and methods of application of the Stabilog Potentiometer Control Pyrometer are described in Bulletin 194-1. Related equipment for automatic temperature control is also covered. The Foxboro Co., Foxboro, Mass. (1314)

Alloy Castings

Corrosion resistant and stainless steel castings are the subject of a new booklet. Chemical and metallurgical properties of these castings are included. Illustrated. Michiana Products Corp., Michigan City, Ind. (1315)

MoTung High Speed Steel

An illustrated booklet devoted to the above, contains information under these divisions: working and treatment, surface protection, high heat temperatures, drawing temperatures, effect of treatments, etc. An index is included. Universal Steel Co., Bridgeville, Pa., and Cyclops Steel Co., Titusville, Pa. (1316)

Surface Hardening by Induction

The TOCCO Process which, it is claimed, reduces hours of surface-hardening time to seconds and produces a scientifically regulated, exact result, is discussed in an attractive illustrated leaflet of The Ohio Crankshaft Co., Cleveland, O. (1317)

Electric Welding Products

Catalog No. 101 contains information on welding rods (recommended uses for the different types, physical properties, welding procedure, etc.); miscellaneous apparatus, and Wilson arc welding machines. Air Reduction Sales Co., New York, N. Y. (1318)

Spectrometric Equipment

Catalog D-221 is devoted to the above equipment. Basic theory and designs are described as well as the various types of instruments. Illustrated. Bausch & Lomb Optical Co., Rochester, N. Y. (1319)

Sonittep Products

This booklet discusses heat loss and its control. The advantages of Sonittep insulating cement and its uses are listed. Instructions for its application are included. Graphs. George F. Pettinos, Inc., Philadelphia, Pa. (1320)

High Frequency Electric Power Converters

According to illustrated pamphlets, this company manufactures high frequency electric converters for use in conjunction with numerous industrial induction heating applications such as, the heating of metals for hardening, tempering, drop forging, melting, case hardening, degassing, etc. Lepel High Frequency Laboratories, Inc., New York, N. Y. (1321)

CURRENT NEWS ITEMS

Dr. Jacobus Receives Morehead Medal

The Morehead Medal for the year 1935 has been awarded to Dr. David Schenck Jacobus for his outstanding leadership in the formulation of codes and procedures which have made fusion welding acceptable. The medal was presented to Dr. Jacobus during the opening session of the 37th annual convention of the International Acetylene Association held at Hotel Jefferson in St. Louis Wednesday, Nov. 18.

The Morehead Medal is awarded annually by the International Acetylene Association to the person or persons who, in the judgment of its officers and board of directors, have done most to advance the industry or the art of producing or utilizing calcium carbide or its derivatives. The award was established in 1922 by the Hon. John Motley Morehead, formerly United States Minister to Sweden, in honor of his father, the late James Turner Morehead who, in 1892, sponsored the experiment which lead to the discovery of the electric furnace method of producing calcium carbide.

Perkin Medal Award

Dr. Thomas Midgley, Jr. has been elected to receive the Perkin Medal of the Society of Chemical Industry for 1937. The medal is awarded annually for valuable work in applied chemistry and will be presented this year to Dr. Midgley for his work in the development of antiknock motor fuels, safe refrigerants, etc. The selection is made by a committee representing the five chemical societies in the United States. The medal will be presented on January 8 at a meeting to be held at The Chemists' Club. Details will be announced later.

Symposium on High-Strength Constructional Metals

This symposium comprises five extensive technical papers and discussion presented at the 1936 A. S. T. M. regional meeting. The papers cover the chemical and physical properties and manufacturing and fabricating properties of metals and alloys applied for various constructional applications including buildings, ships, automobile bodies, airplane wings, tanks, etc.

The papers give the latest information and data on the following: Carbon and low-alloy steels, corrosion-resisting steels, alloys of copper, alloys of nickel, and alloys of aluminum and magnesium. There are a great many charts and tables of data in the symposium, thus presenting much of the valuable and extensive information in condensed form.

Copies of the publication of 126 pages can be obtained from A. S. T. M. Headquarters, 260 S. Broad St., Philadelphia, at $1.25 heavy paper binding; $1.50, cloth binding.

New Research Laboratory for Armco

Construction of a modern research laboratory to replace the research building which was leveled by an explosion in December, 1935, was announced today by The American Rolling Mill Co.

As a result of an extensive research program of long standing, Armco has developed many special grades of iron and steel sheets which comprises a large part of the company's production. Since the demolition of the laboratories, the management has been studying the problem and has now decided to proceed with the construction of a new building with proper and modern facilities to house this most important function.

This building, to be erected in Middletown of porcelain enameled sheets, other decorative metal products, and glass blocks, will cost approximately $260,000, exclusive of equipment. A multiple-story building of equal floor space but of conventional construction, would cost about $400,000, the announcement said.

The laboratory, a single-story building designed and to be erected by The Austin Co., national organization of industrial engineers and builders, is the outgrowth of extensive research which led to the use of sheet iron and steel as building materials. The American Rolling Mill Co.'s development of the continuous process for rolling sheets is of far-reaching interest to the building trade because this method of rolling sheets greatly widened the use of sheet metal through the substantial reduction in cost.

Fritz Medal to A. N. Talbot

Arthur Newell Talbot, professor emeritus of engineering in the University of Illinois, has been awarded the 1937 John Fritz Gold Medal, highest of American engineering honors. Prof. Talbot, who is 79, was cited as "molder of men, eminent consultant on engineering projects, leader of research, and outstanding educator in civil engineering." The award is made annually for notable scientific or industrial achievement by a board composed of 16 past-presidents of the four national societies of civil, mining and metallurgical, mechanical, and electrical engineers.

Prof. Talbot has been president of the American Society of Civil Engineers, the Society for the Promotion of Engineering Education, and the American Society of Testing Materials, and is a member of many other professional organizations. He received the Washington Award in 1924, the Turner Medal in 1928, the Henderson Medal of the Franklin Institute in 1931, and the Lamme Medal of the Society for the Promotion of Engineering Education in 1932. He is the author of many technical articles, and has contributed to professional journals.

Among the recipients of the Medal have been Lord Kelvin, Thomas Edison, Guglielmo Marconi, Elihu Thomson, John R. Freeman, John F. Stevens, Elmer A. Sperry, Daniel C. Jackling, M. I. Pupin, J. J. Carty, J. Waldo Smith, Frank Julian Sprague, and William Frederick Durand.

Aircraft Tubing Data

Those interested in aircraft engineering will be rewarded in studying a publication recently issued by the Summerill Tubing Co., Bridgeport, Pa. It is entitled "Aircraft Tubing Data" and contains "a great deal of information that is absolutely new." This is particularly true of the column strength curves which are plotted for the first time to cover 75,000 lbs. and 55,000 lbs. per sq. in. minimum yield. The data on properties of steel tubing are also assembled in a more commercial form for quick reference. There are 40 pages of data and charts. It is available at a cost of $1.00.

Luncheons by General Motors

Prior to and during the National Automobile Exposition in New York, Nov. 11 to 18, two luncheons were given by the General Motors Corp. which were of unusual interest.

On Nov. 10, in the Empire Room of the Waldorf-Astoria Hotel, a luncheon was tendered to Charles F. Kettering, vice president in charge of research of General Motors, by Alfred P. Sloan, Jr., president, in honor of the invention 25 yrs. ago by Mr. Kettering of the electric self-starter. Some 200 business executives, editors and professional men were in attendance.

A de-luxe Cadillac touring car of 1911 was exhibited on the stage and a self-starter of that vintage was unveiled during the post-prandial speeches. These were delivered not only by Mr. Sloan and Mr. Kettering, but also by Edwin C. Hill, E. V. ("Eddie") Rickenbacker, Daniel H. Cox and W. A. Harriman, all associated with subsidiary units to General Motors.

The other luncheon was tendered to editors of trade and professional papers at the University Club, Friday, November 13, at which about 75 sat down. The after-luncheon discussion was in charge of O. E. Hunt, chief engineer, who solicited questions which were interestingly answered by Mr. Kettering, the honor guest, and by Mr. Hunt and other representatives of the organization.

The permanent exhibition on the third floor of the International Building, Rockefeller Center, New York City, will hereafter be known as the Metals and Plastics Bureau. Diversification of the displays which constantly show new developments in the metals industry and the plastic industry, has resulted in a sustained demand for a name to indicate the scope of its activities.

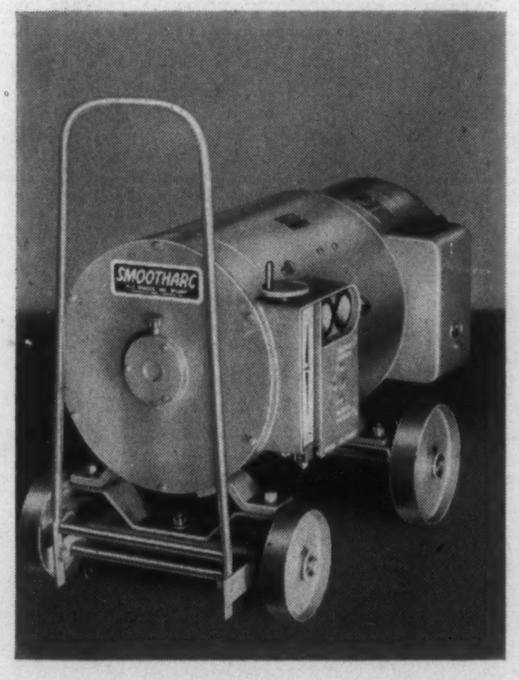
Establishing a permanent center for the display of metals, alloys, plastics and finishes, so that improved products and new applications could be examined at leisure, was a service rendered by its predecessor and the Metals and Plastics Bureau continues unaltered such activities.

NEW EQUIPMENT AND MATERIALS

New Line of P&H "Smootharc" Welders

The Harnischfeger Corp. of Milwaukee announces a new line of "Smootharc" welders featuring simplified design not only in outward appearance, but in operation as well with single current control, self-excitation and internal stabilization. These new welders are built in both vertical and horizontal types for stationary or portable mounting. The vertical units, compactly and uniformly designed, come in three sizes, 75, 100 and 150 amps. The horizontal units in 200, 300, 400 and 600-amp. capacities, are streamlined to minimize projecting parts, and present a neat compact appearance, all of which assure easy portability.

All sizes of the new P&H-Hansen Welders are provided with single current control, made possible by the patented design of shifting generator brushes. Through the medium of a micrometer screw device the brush shifting gives an infinite number of current settings. Open circuit voltage is maintained at a desirable high value at all current settings through the exclusive P&H design. The voltage regulation is automatic and requires but a turn of the hand wheel control to adjust the welding current. All of which permits easier, faster and better welding.



Self-excitation, an additional feature, is accomplished through a set of auxiliary brushes placed ahead of the main brushes and connected to an auxiliary shunt winding. By means of the specially designed generator, the auxiliary brushes operate in a magnetic field independent of the main field. The auxiliary brushes attached to the main brush ring are shifted simultaneously with the main brushes, thus regulating the proper amount of excitation made available at each current setting.

Through the use of interpole winding extended to the main pole shoes in such a manner that it serves the dual function of interpole winding, all "Smootharc" Welders are internally stabilized. Speedy arc recovery is secured through the combination of short circuit winding and the magnetic bridge located in the main field magnetic circuit.

In this new line of welders the generator instruments are concentrated in a single control panel built into the side of the generator frame. The a.c. motor starting box is built into the side of the motor housing. The streamlined appearance is accomplished through the use of all rolled steel and arc welded construction. All steel parts, field ring, pole shoe, etc., are annealed to give the highest possible quality magnetic field for generator fluxes.

New Low Temperature Brazing Alloy Sizes

The intense interest in low temperature brazing, together with the wide and growing variety of purposes for which silver brazing alloys are being used, have made it necessary for Handy & Harman, 82 Fulton St., New York, makers of "Sil-Fos" and "Easy-Flo," to add new sizes and forms to their standard price list to more promptly meet the increasing requirements.

Prices of these two alloys have not changed but additions to the standard sizes formerly carried in stock have now been included in a new combined price list covering Sil-Fos and Easy-Flo as well as Handy Flux, the use of which is necessary if full advantage is to be taken of the brazing alloys' low melting points. The new price list became effective Monday, Nov. 2.

To the former stock sizes of Sil-Fos—used for joining non-ferrous metals—a new strip thickness, 0.005 in. has been added in widths of ¼ in. or more. To the wire forms standard with Easy-Flo until now, a new wire size 3/64 in. has been added and four new gages of strip 0.020, 0.010, 0.005 and 0.003 in.-¼ in. or more in width, which should meet practically all requirements. For special applications, additional forms and sizes including washers, circles, rings and filed or powdered forms are still available and prices can be obtained on application.

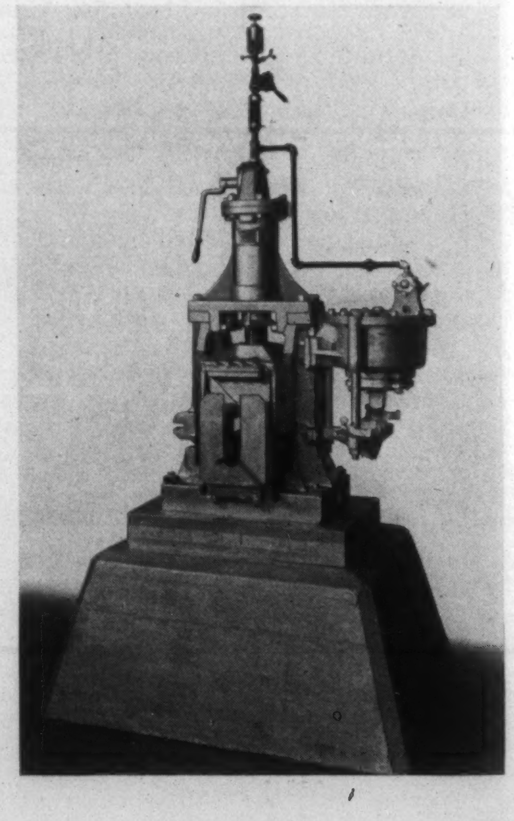
The increased use of these alloys is attributed to their exceptionally low melting points and the strong, ductile joints they make. Sil-Fos, free flowing at 1300 deg. F., joins copper, brass and bronze permanently and at low cost while Easy-Flo requires only 1175 deg. F., the lowest melting point of any brazing alloy giving high strength. The latter is used with both ferrous and non-ferrous metals and especially for joining steel, stainless steel, Monel metal and other Cu-Ni and Cr-Ni alloys as well as dissimilar metals such as copper to steel. Both alloys, because of their low flow points and the speed with which they can be applied, join metals without damaging physical qualities. Because Handy Flux is entirely fluid and active at 1200 deg. F., full advantage can be taken of the low melting points of these two brazing alloys.

In keeping with the growing use of low temperature brazing alloys, distributing and servicing facilities have been arranged throughout this country and Canada. Standard sizes can be obtained promptly from Handy & Harman with plants in New York, Bridgeport, Providence and Toronto, Canada, and from distributors located in all of the principal industrial centers in the country.

Improved Rod Straightener and Shear Machine

An improved rod straightener and shear machine is announced by The American Foundry Equipment Co., 555 S. Byrkit St., Mishawaka, Ind. The "American Rod Straightener and Shearer" was designed for reclamation of rods, bolts, wire and nails. It will reduce scrap piles, save labor and materials and pay profits through salvaged materials which formerly constituted waste. Laborers, formerly occupied in straightening rods by hand, can be put to more profitable work in other capacities. Rapidity of operation in both straightening and shearing is limited only by the speed of the operator in feeding stock into the machine.

The American Rod Straightener and Shear machine is made in all sizes from a small hand operated model with a maximum straightening capacity of ¼-in. rods to a large compressed air unit with maximum straightening capacity of 2½-in. rods. With the exception of the hand operated model, all of the machines are operated by compressed air, 60 lbs. being the minimum pressure for satisfactory operation.



The straightening mechanism is composed of manganese steel dies which close as a contracting square on the rod or bar and deliver an impact on four sides simultaneously. Operation is controlled and the force of the blow is regulated by a hand control lever which actuates the air throttle valve. A gagger attachment is obtainable on several of the models.

The machine is constructed of cast steel with the exception of cylinder parts which are cast iron. Maintenance expense is practically eliminated because of the sturdy construction. Operating expenses are negligible as the machine does not require skilled labor.

Armco Galvanized "Paintgrip" Sheets

Full commercial production of a new kind of galvanized sheet that assures a good paint bond on iron and steel products has been announced by The American Rolling Mill Co., of Middletown, Ohio. Introduction of "Armco Galvanized Paintgrip" sheets follows several years of intensive research on the part of Armco's metallurgists and the technicians of the Parker Rust-Proof Co. This new kind of galvanized sheet metal can be painted without special treatment of the surface by the user.

Armco Paintgrip sheets, the manufacturers say, are chemically treated to produce a fine crystalline phosphate coating which in itself is neutral to paint (being neither acid nor alkaline) and keeps the paint from direct contact with the zinc surface. This coating is an integral part of the sheet and is slightly granular in nature.

Armco Paintgrip sheets are available in any of the grades of galvanized sheets manufactured by the company. Analysis of the base metal can be that of Armco Ingot Iron, plain or copper-bearing steel. When it is required, all grades of these sheets can be supplied stretcher leveled. Forming qualities of Armco Paintgrip sheets are the same as untreated galvanized sheets. They may be soldered satisfactorily with the use of hydrochloric acid as a flux.

Formation of a Paintgrip coating on metal is dependent upon the fact that phosphoric acid solutions will dissolve zinc phosphate within certain definite limits. Passing zinc coated iron or steel products through such a solution results in the formation of the Paintgrip coating which becomes an integral part of the metal surface at the point of solution. Reaction takes place with the evolution of hydrogen, continuing until the metal surface is completely converted to a crystalline phosphate coating.

Mechanical Device for Handling Heat-Treated Materials

A cooperative arrangement has been effected between the Ajax Electric Co., Inc., Philadelphia, and Continental Engineers, Inc., Chicago, which should be of considerable interest to prospective furnace purchasers. The Ajax Electric Co., Inc., has developed an extremely economical and low maintenance salt bath known as the Ajax-Hultgren furnace, which may be used for liquid heat treating, case hardening or other metal heating operations. It is regarded as a large step in advance of the present art, and is fully covered by broad patents. Continental Industrial Engineers, Inc., have developed and patented a comprehensive system which mechanically moves materials being heat treated through a predetermined cycle, as for example, preheating in cyanide pots, quenching, rinsing, washing and drawing.

Because of the many advantages of the Ajax-Hultgren furnace, it fits in ideally into the Continental system. The Continental system makes possible very economical and uniform heat treating and practically eliminates handling. Since all operations are timed and mechanically controlled, both as to temperature and speed, each part must be exactly like the other parts.

It is anticipated that this cooperative agreement will be very much to the interest of furnace users as they may purchase this type of equipment with the assurance that the two outstanding companies in this field are cooperating to see that the resultant product is the best obtainable.

Acitrol 100, a New Inhibitor

Based on the acknowledged principle of setting up an electrolytic insulating film where steel is attempting to dissolve, E. F. Houghton & Co., Philadelphia, introduces a new inhibitor, "Acitrol 100." This exerts an electrolysis control which differentiates between the productive and nonproductive galvanic couples present in a pickling solution. It is especially designed to include high dielectric strength, great cathodic affinity and freedom from breakdown.

Acitrol 100 is a synthetically manufactured, pure chemical powder inhibitor which dissolves rapidly in either strong or weak acid solutions, and leaves no greasy residue or stain on the steel. The loss of an inhibitor due to breakdown determines its ultimate cost and the economy of Acitrol 100 is proven in its showing of practically no breakdown at boiling temperatures over long periods of time. Acitrol 100 costs less to use per ton of steel both because of its initial strength which is far above the average, and its stability.

A New Coated Electrode

Metal & Thermit Corp., 120 Broadway, New York, announces an addition to its line of Murex heavy coated electrodes for arc welding. The new electrode, known as "Murex Type N," is designed for bridging gaps where fit-up between plates is poor and, in the smaller sizes, may be used on vertical and overhead work, or to make rapid, single pass welds on light gage materials. In addition, it will produce clean, sound, single or multiple pass fillets.

The physical properties of the metal deposited by the Murex Type N electrode are said to range from 74,000 to 84,000 lbs. per sq. in. in tensile strength with 26 to 24 per cent ductility. The new electrode is also said to work equally well with either d.c. or a.c. and may be used either with straight or reversed polarity.

Cements *that* Stand Up!

"SHAMVA" MULLITE
Shamva Products

The same high temperature performance as "Shamva" Mullite bricks and shapes

If you wish the best grade of cement it is possible to get, for bonding brick work—for a wash to resist flame cutting, and slag, gas and dust penetration—for ramming linings—and for repairs of every kind, you will find it in one of the following "Shamva" products:

SM40—*Mortar Cement*—Stubbornly resists flame cutting and the penetration of corrosive and dust-laden gases. A high quality bond for brick work.

SM50 — *Dry Patching Cement* — Air setting. Sets cold and forms a very strong bond. Excellent for small patching, coating walls, or pointing up cracks. An ideal wash for brick work.

SM60—*Plastic Patching Cement* — Molds to any shape, for furnace interiors and doors or monolithic structures. Perfect for filling holes or for replacing entire brick sections.

SM70—*Ramming Cement* —For ramming furnace linings, special shapes or monolithic walls with air hammers. Sets readily, does not shrink, giving long service.

Write for catalog describing the entire "Shamva" line

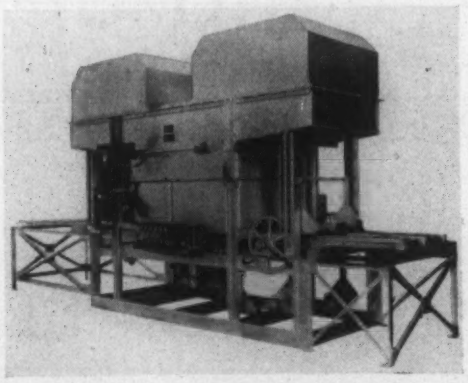
THE MULLITE REFRACTORIES COMPANY, 9 CANAL STREET, SHELTON, CONN.

Shamva
MULLITE
THE 3300° SUPER-REFRACTORY

Automatic, Vapor-Type Degreaser

The automatic, conveyorized, vapor-type of Detrex Degreaser has been recently designed and built by the Detroit Rex Products Co., 13005 Hillview Ave., Detroit, for the cleaning of heavy gage metal parts. This machine is equipped with a 2-strand, cross-rod type of conveyor, which has a variable speed drive. There are 17 special fixtures suspended from this conveyor on 30 in. chain centers to handle the work baskets through the degreaser. Roller-type gravity conveyors at each end of the machine provide automatic loading and unloading. Electric immersion heaters, and thermostatically controlled magnetic relay and line switch are used. The machine is also equipped with a full automatic vapor level control device.

This model of degreaser is built in various sizes to accommodate production requirements. The particular machine shown is 20 ft. long, 6 ft. 3 in. wide by 9 ft. 8 in. high. It has a rated production capacity of over 6,000 lbs. of heavy gage metal parts per hr. at a conveyor speed of 1 ft. per min. Parts are received on this gravity roller conveyor loaded in grill-type metal baskets having perforated plate separators. These work baskets are automatically lifted from the conveyor fixtures and carried through the machine. While in the machine, the parts are subjected to vapor cleaning in pure solvent vapor—either "Perm-A-Clor" or "Triad Safety Solvents" being used. The baskets of work on being conveyed out the opposite end of the machine are automatically transferred onto the gravity rolls at the exit end. From here they are conveyed to the following heat treating or finishing operations (depending upon the requirements of the work). The complete cycle of vapor cleaning requires only about 4½ min. The work is removed from the machine perfectly free of oil and dry.



Despatch Convected Air Gas Fired

A radical departure from the conventional present day tempering and drawing furnace, the new "Despatch Dense Load Convected Air Gas Fired Furnace" of the Despatch Oven Co., Minneapolis, Minn., sets new high standards for performance.

The new design incorporates numerous features which assure positive uniformity of tempering and drawing results, precise temperature control, high production capacity, genuine operating economies, rapid heat transfer and many other operating advantages.

Operating uniformity is guaranteed to be plus or minus 5 deg. F. at 1200 deg. F. Preheating is rapid because large volumes of air under high pressure are driven through the loads. Without the use of complicated step-down control systems, Despatch Dense Load Furnaces maintain the set operating temperature within 5 deg. F. plus or minus at 1200 deg. F. There is no overshoot of temperature. They offer greater production per unit because the heat transfer rate is high and the furnace operates with high efficiency.

Gas is an economical and low priced fuel. Naturally the cost of drawing and tempering is lower per pound of material processed than when using a more expensive heating medium, such as electricity. High capacity high pressure blower forces heated air uniformly through every portion of the load. Parts are always drawn and tempered uniformly no matter how dense the load.

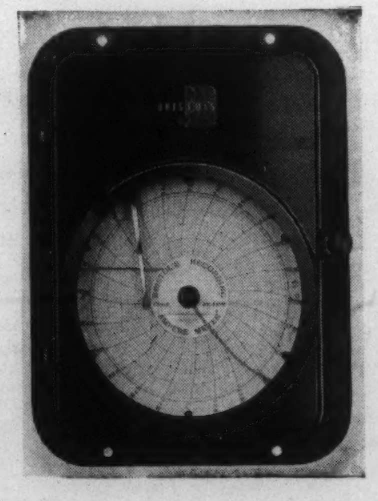
Low working height, top loading system, and minimum floor space requirements make the furnace ideal for the crowded commercial shops and production departments. Recessing of units is not required. All furnaces are designed for floor mounting. They are arranged for temperatures up to 1200 deg. F. Quick changes from one temperature to another when required to smoothly handle various production demands eliminate wasted time and bring about increased production.

Ruggedness of the design and construction of this furnace assures uniformly and thoroughly tempered and drawn parts with a minimum of operating cost, time, and maintenance expense.

New Line of Round Chart Recording Voltmeters and Ammeters

A new line of "Round Chart Recording Voltmeters and Ammeters" is announced by The Bristol Co., Waterbury, Conn. These new instruments have been developed to take care of the requirements of electric utilities for accurate, rugged instruments that are easy to use and service. They also are intended to fill the requirements of industrial plants, especially for process work where voltage and current affect the quality and cost of manufacture of the product.

The new electric recorders are offered in models for wall, switchboard, flush panel, and pole mounting, and for portable use. These instruments are housed in a very practical moisture-, fume-, and dust-proof case made of an aluminum alloy. In the design of this case, attention was paid to beauty so that it would harmonize with other modern fixtures and pieces of apparatus.



The measuring element is a separate unit that can be easily replaced by removing only three screws from the mounting. The pen-arm is inverted and is pivoted at the top in such a way that the pen pressure against the chart is delicately controlled by gravity. This eliminates any possibility of sluggishness due to the pen arm becoming bent. The pen arm is equipped with a convenient micrometer zero adjustment and also a replaceable chromium plated tip, which may be removed by loosening only one screw. These new electric recorders are offered with spring-driven and other electric Telechron clocks.

Welding Robot Uses Standard Rods

New impetus was given to the development of arc welding in all kinds of metal fabrication work with the announcement of an entirely new automatic welding head; the first of its kind to use standard coated rods, thus putting welding on a mass production basis with the uniform high-speed results obtainable only with this type of electrode. This new automatic welding machine, developed and perfected by the Harnischfeger Corp. of Milwaukee is a true robot operated by remote control. By eliminating the hand-operated electrode holder, this automatic machine makes it possible to use a higher current with welding heats as much as 60 per cent higher, increasing tremendously the speed of producing welding pieces.

Up to 50 standard welding rods are loaded in a magazine and then fed automatically to the welding position. As one electrode is consumed, the remaining butt is ejected and a new, full-length rod is fed into place. The renewing operation takes less than a split second. During this feeding operation, the work table stops and then starts again automatically as the new electrode makes the electric contact. The action is so swift that no break in the welded bead is evident. The arc length is automatically regulated at a constant point during the welding operation. Though the working surface be irregular, there is no apparent variation in the penetration or appearance of the bead.

This new machine can be used on flat work of any length, on circular pieces and, with pantograph attachment, to any shape. It is adaptable for use on lathes, planers, rotating tables, boring mills and with wall cranes, for welding long girders, etc. In addition to its greater speed and accuracy it substantially reduces the cost of many welded pieces.

"Hackett K-Copper"—A New Copper Alloy

A new copper alloy, that will be especially interesting to manufacturers and users of welding equipment, is being marketed under the name of "Hackett K-Copper" by its producers, the Hackett Brass Foundry, Detroit.

Hackett K-Copper is claimed to combine the physical properties of steel and bronze with the high electrical and heat conductivity of copper. Compared with pure copper it has equal corrosion resistance, the same coefficient of expansion, coefficient of resistivity and modulus of elasticity. It has a hardness of 70 to 80 Rockwell B (125 to 150 Brinell), ultimate strength of 70,000 lbs. per sq. in., elongation approximately 20 per cent, reduction in area 50 per cent. In drawn rod 83 per cent, it has the electrical conductivity of pure drawn copper, in forged form 75 to 85 per cent that of forged copper.

The alloy is available in bars, forgings and castings and is being widely used for welding tips and holders. The producer uses it in the manufacture of a wide range of standard and special designs of spot welding tips which have demonstrated important savings for operations of welding machines. The Hackett K-Copper tips are reported to mushroom less easily than pure copper, require dressing less frequently and deliver a greater number of welds per tip.

New Sintered Carbide Plant

The Firth-Sterling Steel Co., McKeesport, Pa., has announced that it will erect at its local plant a new building as a result of increasing production demands. The building is to be two stories in height and will be erected so that more floors can be added. It is to be used for the manufacture of tungsten carbide tools and dies, merchandising under the trade names of "Firthaloy" and "Firthite." It is to be 210 ft. long, 95 ft. wide and will be located adjacent to the existing buildings at Demmler in such a manner that it can be extended in three directions.

The construction of the new building has started and is designed in an ultra-modern style, in keeping with the Firthite-tungsten carbide process which is something new in the field of metallurgy. The building is to be equipped with dust removal and recovery system, and parts of it, where the manufacturing process is particularly noisy, are to be sound-proofed. As the manufacturing process of tungsten carbide necessitates extremely hard wearing surfaces, as well as clean working space, the interior walls and floors will be given special finishes to meet these requirements and air will be filtered and conditioned. The Rust Engineering Co., Pittsburgh, has been awarded the contract for the building and expects to complete the work the latter part of this year.

New Corrosion Resistant Specialties for Use in Plants Handling Corrosive Agents

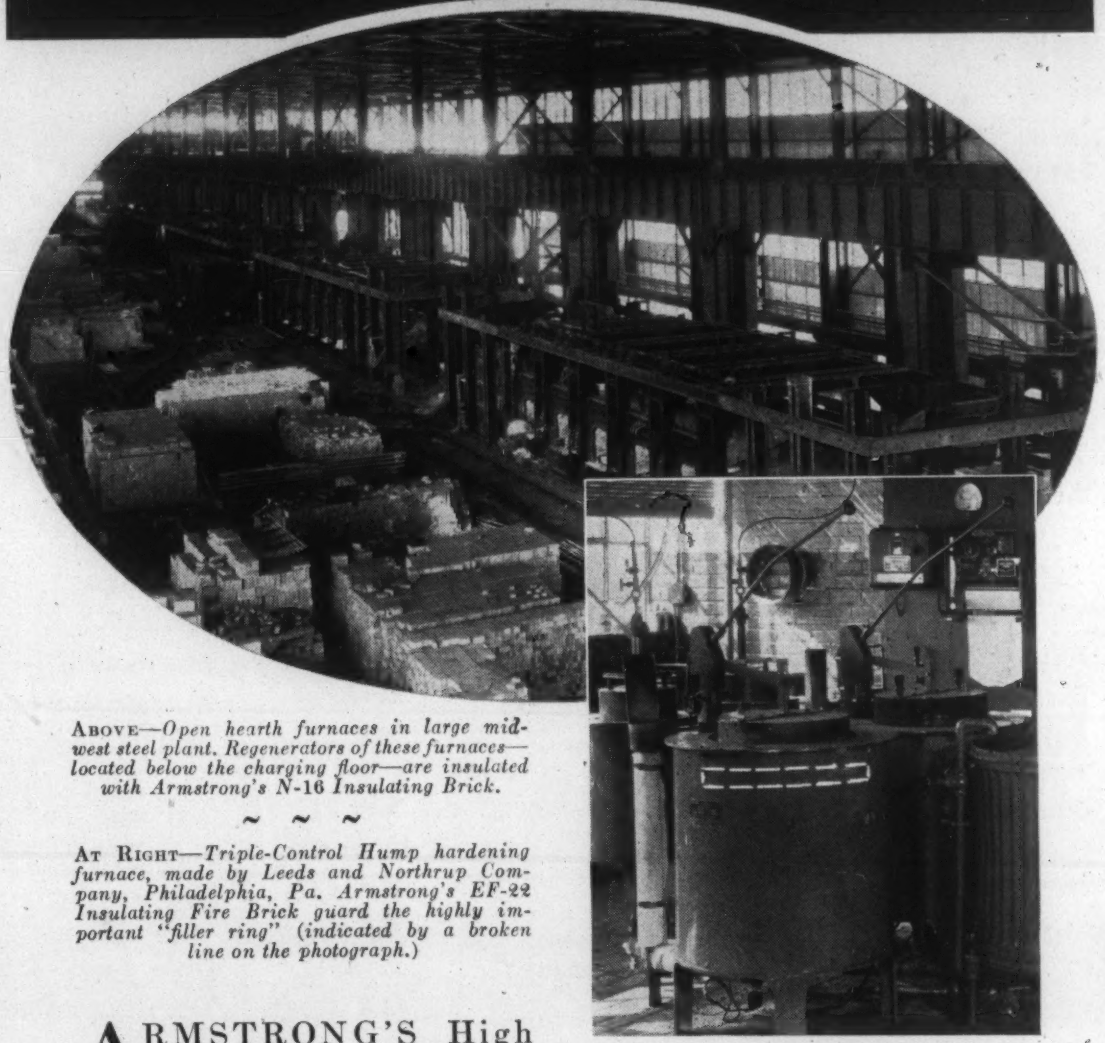
Two new products designed to meet corrosive problems in a variety of plants where acid, alkali and other corrosive agents are encountered have just been announced by manufacturers. One of these is a Monel caster for trucks, hampers and wheeled conveyors of all kinds. Available in both the stationery and swivel roller type, it is adapted to use in chemical, processing plants, laundries, dry cleaning and similar establishments where the corrosive materials are liable to spill over on the floor.

Metal parts of the caster are entirely of Monel, including bearings, shaft and spacers. Wheels are of a special rubber composition. The casters are manufactured by the Bassick Co., Bridgeport, Conn.

The second piece of equipment is designed for use in similar plants and is a special adaptation of an earlier piece of equipment. This is the Whitehead graduated type Monel pail, now made available in standard sizes of 12, 14 and 16 qts. Its development follows the general acceptance of the non-graduated type of Monel pail which has been on the market for several years.

Bottom and sides are of 0.037 in. Monel electrically seam welded. The chime also seam welded is 0.078 in. thick and is seam welded to project ½ in. below the bottom. Monel ears are spot welded to the sides. The handle is 5/16 in. Monel rod and the rim is rolled over a 3/16 in. wire. The seam cannot break open and there are no rivets at which leaks can start.

For every type of furnace
LARGE or SMALL
ARMSTRONG'S BRICK ASSURES FULLEST INSULATING EFFICIENCY



ABOVE—*Open hearth furnaces in large mid-west steel plant. Regenerators of these furnaces—located below the charging floor—are insulated with Armstrong's N-16 Insulating Brick.*

~ ~ ~

AT RIGHT—*Triple-Control Hump hardening furnace, made by Leeds and Northrup Company, Philadelphia, Pa. Armstrong's EF-22 Insulating Fire Brick guard the highly important "filler ring" (indicated by a broken line on the photograph.)*

ARMSTRONG'S High Temperature Products meet the insulation requirements of every type of furnace. Whether insulation is needed for a large open hearth furnace, or for use at a critical point in a small hardening furnace, there's an Armstrong Brick to do the job efficiently!

Armstrong's complete line of High Temperature Products includes: Armstrong's N-16, N-20, and A-25 Insulating Brick for temperatures up to 1600°, 2000°, and 2500° F., respectively, behind the refractory; and Armstrong's EF-22 and EF-26 Insulating Fire Brick for use without fire brick protection up to 2200° and 2600° F., respectively. These brick are made with technical expertness and care which assure uniformity and accurate sizing. Moreover, repeated testing keeps them consistently up to Armstrong's rigid specifications for quality.

Use of Armstrong's Brick provides accurate temperature control, savings in fuel, and speeding up of production. Write today for the free, illustrated booklet, "Armstrong's High Temperature Products." Armstrong Cork Products Co., Building Materials Division, 982 Concord St., Lancaster, Penna.

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A troublesome job done easily by EASY-FLO PATENTED

BRASS
STEEL
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—the low-temperature brazing alloy for low-cost joining of dissimilar metals

A ¾″ yellow brass tube, a stamped circular body of steel only .015″ thick—and a joint which must withstand constant vibration at temperatures up to 300 deg. F.—this was the problem in manufacturing this auto engine oil float.

The right answer was found in EASY-FLO Brazing Alloy. As in many other jobs, EASY-FLO in this case is producing sound, ductile joints without damage to the physical qualities of surrounding metal and does this work at surprisingly low cost.

These joints are made at the rate of 70 per hour per operator. The cost, including EASY-FLO, HANDY FLUX, oxygen, acetylene and labor, totals 1.69 cents per joint—a little over one and one-half cents for insurance against trouble in a joint where dependable strength is so important.

EASY-FLO offers high strength and economy in joining a wide variety of metals — steel, stainless steel, Monel Metal, Inconel, copper, brass, bronze, nickel and many other copper-nickel and chrome nickel alloys. Its low melting point—1175 deg. F.—makes it easy to guard against damage due to overheating. It flows rapidly, penetrates deeply, and offers good corrosion resistance.

●

Try EASY-FLO on your difficult or troublesome joining problems and on your regular production too. Write us for full information, or send details of your specific brazing job. We will be glad to cooperate with you.

HANDY AND HARMAN 82 Fulton St., New York

THEY'LL FIGURE ALL WEEK

to save a Penny!

WHEN you're turning out a product by the hundred thousands, a saving of even a fraction of a cent on production quickly runs into important money. No wonder engineers, designers, and shopmen burn the midnight oil, sweat over ways and means to trim costs.

In these round-table discussions Carnegie-Illinois Controlled Steels are getting increasingly important consideration. For it is now a matter of record that these steels are accomplishing remarkable savings.

In one plant, for example, they needed a steel that would give uniform response to heat treatment, that would forge readily, machine easily. They gave Controlled Steels a trial. Costs dropped—not one penny . . . not five cents . . . but 78¢ per part—and their production runs close to a quarter of a million parts a year.

What are Carnegie-Illinois Controlled Steels? Briefly, they are steels for forging, forming, heat treating and machining, in which *all* quality factors can be definitely pre-determined . . . steels in which the physical properties are kept consistently uniform in shipment after shipment. Scientific metallurgical control eliminates those "mysterious differences" which make it so difficult to obtain uniform results with ordinary steels.

It costs nothing to find out how they may be used to cut your steel bills or reduce your fabricating cost. We welcome the opportunity to discuss this important matter with you.

Controlled

STEELS

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